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The Effects of Drive and Reward upon Concept Formation in Schizophrenia

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Chapter I. Introduction

The conceptual deficit in schizophrenia has been described as the inability to think abstractly (Goldstein, 1944, 1947, 1959) and, conversely, as the tendency to over-abstract, to over-generalize, and to over-include (Cameron, 1944). Clinical experiences with schizophrenics in a short-term, inpatient psychiatric hospital have revealed to this writer a waxing and waning of the schizophrenic's ability to abstract and conceptualize. Occasionally the schizophrenic seems to possess remarkable conceptual capacities, yet, most frequently, such abstracting abilities are clearly not utilized. Investigating the schizophrenic conceptual deficit, McGaughran and Moran (1956) found chronic paranoid schizophrenics to be similar to non-psychiatric control subjects in their conceptual abilities, but the schizophrenic's ability to communicate socially was found to be limited. This dissertation provided a method of evaluating several other parameters of the conceptual functioning of psychiatric in-patients and of schizophrenics in particular.

The purpose of this study was to clarify the nature of the conceptual deficit in schizophrenia, by investigating the effects of drive and reward as motivational variables and by examining the effects of the complexity of the conceptual task itself.

Hypotheses

The first of three hypotheses (I, II, III) were derived from three primary conceptualizations of schizophrenic thought processes: Cameron (1944); Goldstein (1944); and Mednick (1958). Hypotheses I, II and III are this researcher's applications of Cameron's, Goldstein's and Mednick's points of view. It must be emphasized that these hypotheses are those that each theoretician would predict. This experimenter did not expect Cameron's, Goldstein's, or Mednick's theories to be supported. Instead, Hypothesis IV reflects the expectations of this experimenter. Hypothesis IV, then, is essentially contradictory to Hypotheses I - III and represents the primary concern of this dissertation.

First, Cameron's (1944) over-generalization, overinclusion concept suggests that schizophrenics should perform more poorly than nonschizophrenics on conceptual tasks (Hypothesis 1A). Also, Cameron suggests that a schizophrenic confronted with a complex problem would function more poorly than one confronted with a simple problem (Hypothesis 1B). Second, Goldstein's (1944) concept that the schizophrenic thinks in a concrete fashion to avoid catastrophic anxiety indicates that a schizophrenic should perform more poorly than nonschizophrenics on conceptual tasks requiring abstractions (Hypothesis IIA). If concrete thinking does result from avoiding catastrophic anxiety, then it would be expected that low drive schizophrenics would function more poorly on conceptual tasks than high drive schizophrenics (Hypothesis IIB). That is, low drive schizophrenics have already minimized their drive levels by thinking in a concrete fashion, while high drive schizophrenics can abstract better, since they have not yet brought their anxiety under control by thinking in a generally concrete fashion.

Third, Mednick (1958) suggests several hypotheses based upon learning theory. Because high drive should foster greater generalization in responding to irrelevant cues, high drive subjects should have more difficulty in concept formation than low drive subjects (Hypothesis IIIA). Hill (1960) believes that increased drive would strengthen the relevant response in an amount directly proportional to the irrelevant responses. This researcher agrees with Hill (1960) and expects that high drive and low drive subjects should conceptualize in a similar fashion (Hypothesis III A1). Mednick suggests further that on complex tasks, high drive will elicit more irrelevant responses than will low drive. Thus, an interaction between drive and the complexity of conceptual tasks should be significant (Hypothesis IIIB). Also, high drive subjects should function more poorly than low drive subjects on complex tasks (Hypothesis III B1) and better than low drive subjects on simple tasks (Hypothesis III B2). Mednick suggests that a significant interaction should be expected between a classification of schizophrenia and nonschizophrenia and drive levels of high and low drive (Hypothesis IIIC). Schizophrenics should function better than nonschizophrenics on simple tasks (Hypothesis III C1) and more poorly than nonschizophrenics on simple tasks (Hypothesis III C1) and more poorly than nonschizophrenics on complex tasks (Hypothesis III C2).

The above predictions, with the exception of Hypothesis III A1, are those predictions which would be made by Cameron, Goldstein and Mednick, but not by this experimenter. Those three theoreticians have not equated their subject samples for drive levels and therefore may be somewhat inaccurate in their conceptualization of schizophrenia. That is, the schizophrenic thinking deficit which they describe may have nothing to do with schizophrenia as such. The deficit may instead be related to differences in the drive levels of the schizophrenic group and the nonschizophrenic group. Therefore, if drive levels are equated for a schizophrenic and a nonschizophrenic group, it is the expectation of this researcher that no significant differences in the concept formation processes will obtain between schizophrenics and nonschizophrenics (Hypothesis IV).

No specific hypotheses were made regarding the effects of nonverbal, non-aversive reinforcement upon concept formation, since this was essentially an exploratory aspect of the project.

Also, the relationship of palmar sweat measurements to the other variables was an exploratory aspect.

Chapter II. Review of Relevant Literature

A controversy has existed for several decades regarding the nature of the conceptual deficit in schizophrenia. This controversy had originated primarily in Goldstein's theoretical approach that the schizophrenic dificit, which he defined as the inability to think abstractly, was essentially an attempt to avoid catastrophic anxiety (Goldstein, 1944, 1947, 1959). Another view was taken by Cameron (1944) who emphasized the schizophrenic's tendency to think over-abstractly, to overgeneralize, and to engage in the overinclusion of stimuli. Much of the recent research has tended to support Cameron, as well as to lend credence to another of Cameron's hypotheses that situations involving interpersonal relationships are emotionally arousing for schizophrenics and contribute to their conceptual deficit (Cameron, 1938, 1944; Cameron and Magaret, 1951). Until the middle 1950's there had been little consideration in the literature regarding the cognitive functioning of particular types of schizophrenia; that is, schizophrenia had generally been considered in reasearch as a unitary phenomena with regard to the thinking deficit. The three theoretical approaches to the schizophrenic deficit, the inability to abstract, the tendency to overinclude, and the anxiety aroused by social situations, do not seem to be in such mutual opposition as the duration of the controversy might suggest. They may instead be directly related, if one considers their implications in terms of a learning theory approach to thinking disorders, with particular emphasis upon the effects of motivation upon the cognitive processes.

Mednick's Theoretical Approach

Mednick (1958) presents an interpretation of schizophrenia based upon Hullian and Spencian principles of learning theory, which suggests an apparent bridge between psychological theory and psychopathology (Johannsen, 1964). As an introduction to his paper, Mednick suggests that stimulus generalization and high levels of anxiety may be "mutually supportive and augmentative." As anxiety increases, the tendency to generalize increases, thus widening the stimulus generalization gradient. On the other hand, Mednick suggests that stimuli which are similar to the original anxiety producing stimulus, or stimulus complex, should contribute to an increased level of drive. It is the intent of this dissertation however, to utilize only the conception from learning theory that high drive contributes to greater stimulus generalization, and not that generalization creates an increased level of drive. It is expected that greater drive and hence greater generalization may contribute to difficulties in sequential thought and concept formation. These difficulties arise because the "effect of heightened drive is to increase the response strength of any habit tendencies that may be aroused in a given situation" (Mednick, 1958). The habit tendencies aroused provide a much larger number of possible responses within a given situation. Perhaps confusion results from the more intense competition of responses during heightened drive. Hill (1960), however, objects to this theoretical framework on the basis that increased drive should not only increase the number of response alternatives, but also should augment the response strength of the correct response in an amount directly proportional to the response strength of the response alternatives.

In addition to stating that the effect of heightened drive is to increase the response strength of any habit tendencies that may be aroused in a given situation, Mednick (1958) also suggests that when the number of response alternatives is restricted, high drive would augment the response strength of the conditioned response. Research has supported this hypothesis. For example, studies in classical conditioning, utilizing limited response tendencies, demonstrate that high drive subjects have greater response strength, i.e., perform better than low drive subjects (Taylor, 1951; Spence and Taylor, 1951; Spence and Farber, 1953). Research has also demonstrated that when response alternatives are restricted, schizophrenics do in fact condition faster, perform better, than normals (Taylor and Spence, 1953; Spence and Taylor, 1953).

In complex learning tasks, many irrelevant and incorrect habit tendencies are aroused, the number of response alternatives are augmented, and competing response situations exist. Mednick (1958) states that high drive, acting impartially upon correct and incorrect response tendencies, will tend to push many irrelevant responses above the evocation threshold. His statement is well supported by research in verbal learning (Hunt and Cofer, 1944). For example, Taylor (1958) found that high anxiety subjects were superior to low anxiety subjects when intralist similarity was low (few competing responses), but were inferior when intralist similarity was high (many competing responses). Mednick then predicts that, since schizophrenics (acute) possess high drive, they will respond more slowly and with more errors than normals in complex task situations.

Mednick relates his hypotheses directly to thinking disorders, in three predictions about performance on psychological tasks which differentiate schizophrenics from normals: (1) schizophrenics more easily acquire a conditioned response; (2) show greater stimulus generalization responsiveness; (3) have great difficulty performing well in complex situations, being plagued by irrelevant, tangential associative responses competing with the adequate mode of response; however, they do at least as well as normals on low complexity tasks.

These predictions hold for both chronic and acute schizophrenics, but for different reasons, according to Mednick. The acute schizophrenic possesses high drive and, therefore, the predictions are made on the drive hypothesis. The chronic schizophrenic evidently exhibits low drive, yet Mednick suggests that the chronic schizophrenic had to experience excessively high drive initially. That is, extremely high drive allows the chronic schizophrenic to respond to the extremes of the generalization gradient. Mednick postulates that responding to irrelevent, non-anxiety producing stimuli, and not to relevent anxiety producing stimuli, reduces the drive associated with the relevant cues, thereby reinforcing the irrelevant responses.

Buss and Daniell (1967) enphasize that Mednick neglects to specify whether his statements about generalization in schizophrenics refer to mediated, verbal generalization and/or to primary stimulus generalization. Mednick (1958) cites dimensions such as pitch (Garmezy, 1952) as providing evidence for his position, yet he seems to apply the theory to both types of generalization. Buss and Daniell's (1967) study utilizes a perceptual, size estimation, generalization task and reveals that the generalization gradient of chronic schizophrenics and normals are not significantly different. However, no statement can be made regarding the more acute schizophrenics, since none were included in the study. The experimenters apparently accept the questionable assumption that chronic schizophrenics possess low drive levels and acute schizophrenics possess high drive levels. It seems highly appropriate then to consider high and low drive levels in schizophrenics in terms of Mednick's theory, rather than on the dimension of acute and chronic schizophrenia.

Broen (1966) attempts to integrate inconsistencies in research on schizophrenia. The contradictory findings cited are:

1.a. Overinclusive concepts have been found in chronic schizophrenics (Chapman, 1961).

1.b. Overinclusive thinking is found in many acute schizophrenics, but chronic schizophrenics are not overly inclusive (Payne, 1962).

2.a. Chronic schizophrenics attend to a narrower range of stimuli than normals (Venables, 1964).

2.b. Chronic schizophrenics are more distractible than normals (Chapman, 1956).

Broen suggests that these contradictions may be clarified by the following propositions: a. response disorganization characterizes both acute and chronic schizophrenics, and b. chronic schizophrenics attempt to cope with response disorganization by observing fewer stimuli. He makes several further hypotheses. First, on a task having a single relevant stimulus which evokes several response tendencies, schizophrenics will show more disorganized variation than normals. Second, in multiple stimulus tasks, acute schizophrenics, possessing an approximately normal breadth of observation and disorganized attention hierarchies, have their attention scattered over a greater range of stimuli than normals or chronic schizophrenics. Third, in multiple stimulus tasks, like acute schizophrenics, chronics possess abnormal response disorganization and abnormally variable attention hierarchies, but only within the limited number of stimuli they have observed. Broen's hypotheses were not tested empirically. Even though this dissertation is not concerned directly with the acute and chronic schizophrenic, Broen's ideas are grounded in a learning theory approach to understanding schizophrenia, and as such provide a feasible conceptual framework which should indeed be considered.

McGhie (1966, p. 282) summarizes much of the existing literature by stating that there is a "fair measure of agreement that schizophrenic patients are pathologically distractible in that they are unable to screen out data irrelevant to the task at hand". Much disagreement exists, however, regarding the nature of the distractibility. Over many studies, McGhie (1966) noted that schizophrenics were at a disadvantage when asked to simultaneously assimilate material in more than one modality. When operating in only one modality, the schizophrenic copes much better in the auditory rather than in the visual modality. However, any type of distraction creates a marked effect on the schizophrenic's auditory task performance.

The schizophrenic deficit has also been related to changes in arousal level (Venables & Wing, 1962). The consensus according to Lang and Buss (1965) is that there is a diminished responsiveness in the autonomic nervous system of the chronic schizophrenic. There is little conclusive evidence, however, justifying the psychophysiological state of the acute schizophrenic as being in a state of hypo- or hyper- arousal (Venables, 1966). Jasper (1958) suggested that the function of the reticular activating system in normal adaptive or integrative behavior may be to prevent a general arousal to all stimuli by selectively responding to significant stimuli. Indiscriminate arousal reactions to all stimuli could only result in chaotic behavior as may be the case in some mental disorders. This implies that inhibitory rather than excitatory functions may be more important, either during sleep or during wakefulness. Venables (1966) points out that the evidence supporting the chronic overarousal of the chronic schizophrenic may possibly be brought about by a failure of inhibitory processes, while in the acute, there seems to be a high degree of variability in arousal patterns. Venables speculates further that the chronic arousal of the chronic schizophrenic is the end result of a process by which an over-labile and weak inhibitory system eventually becomes ineffective.

The controversy regarding the schizophrenic thinking deficit might then be clarified in the following manner.

First, the Goldstein position that concrete thinking is an avoidance of catastrophic anxiety may be interpreted by pointing out that concrete thinking could be the result of high drive and a flattened generalization gradient. Increased drive allows greater stimulus generalization, thereby evoking irrelevant, remote, "concrete" responses limiting the schizophrenic's ability to consider the relevant anxiety evoking stimulus. Secondly, the overinclusion hypothesis seems quite appropriate in that high drive flattens the generalization gradient and allows the subject to overinclude, that is to respond to irrelevant stimuli. Third, social situations may possess sufficient drive producing stimuli which cause more generalization to occur and hence more responses to irrelevant stimuli. The apparently divergent theories regarding schizophrenic thinking may be unified in terms of hypotheses from learning theory. Also, issues regarding arousal might be investigated by measuring the palmar sweating, an autonomic function, of schizophrenic patients.

Motivation

Since we have been discussing the effects of drive and motivation, it is essential to define terms. In his discussion of motivation and thinking, Maltzman (1962) delineates two types of motivational variables: state and process. The state variable refers to a "relatively permanent disposition of the organism where the antecedent conditions are previous interactions of the organism with the environment; "e.g., Hull-Spence D, drive stimuli, hunger, or Taylor's drive interpretation of anxiety. Drive will be defined in Hullian terms as the immediate non-specific state or general condition of the nervous system to which all the specific drives contribute (Hull, 1943). Hull suggests that drive sensitizes both facilitative and irrelevant, interfering habits within a given situation. Furthermore, drive may also be considered as a function of the strength of an emotional response that is aroused by any form of aversive stimulation (Spence, 1958). Process variables include "hypothetical, non-observable, implicit processes occurring in the individual" (Haltzman, 1962) which change rapidly, are labile rather than persistent dispositions, and are the most important sources of motivation for thinking; e.g., K as incentive motivation, or reward. Incentive motivation, valence, or K will refer to the expectations of goodness or badness which will result from a given response. K then refers to the fractional anticipation of pain or pleasure (Campbell, 1962). Both conceptions of motivation, state and process, will be utilized in this study.

Two methods of assessing motivation which have been frequently used in the literature are the Taylor Manifest Anxiety Scale, hereafter referred to as MAS (Taylor, 1953) and the Palmar Sweat Index, hereafter referred to as PSI (Haywood, 1963;

Haywood and Spielberger, 1966). The Taylor MAS is a paper and pencil, self-report questionnaire which consists of MMPI items judged to be associated with the overt expression of or the awareness of anxiety. The MAS has been fairly consistently utilized in the extensive research literature as a measure of drive, which is hypothetical construct based upon a persistent emotional response in the individual. The PSI is a physiological measure based on the phenomena that environmental and sensory stimuli may give rise to anticipatory apprehension and may provoke sweating on the palmar side of the finger tip without affecting a change in general body sweating (Mowrer, 1953; Brutten, 1963).

Experimental Manipulation of Motivation

The intention here is not to review the myriad studies which have manipulated motivation, but rather to discuss briefly those studies having particular relevance for the experimental variables which are intended to be used in this study.

Aversive Reinforcement. It has been rather consistently found that the utilization of aversive stimuli was fairly successful in imporving schizophrenic performance. Probably the first and most classical study was done by Pascal and Swenson (1952) who found that the discriminative reaction time of psychotics and schizophrenics was decreased by introducing blasts of white noise and by requiring rapid responses to terminate this aversive sound. Cohen (1956), utilizing a task involving rote memory and visual motor coordination, improved schizophrenic performance by introducing shock as the aversive stimulus. Similar results, also using shock, were obtained by Rosenbaum, Grissell and Meckevey (1957). Some experiments used a more complex task than the instrumental conditioning of motor responses. Cavanaugh (1958) found that an aversive stimulus, white noise, improved the performance of schizophrenics even on a concept formation task. This task required the subject to arrange the five cards in each of eleven sets of five cards in hierarchical order according to a logical, relational concept; e.g., #1 to the sizes of boxes and #7 according to the period of architecture depicted. Cavanaugh unfortunately reports no differentiation regarding acuteness or chronicity of the schizophrenic sample which he used. Cowden (1962) demonstrated that the performance of his seventeen schizophrenics on anagram problems improved markedly when using white noise as an aversive stimulus. Cowden also included 17 organics in his subject sample who were markedly debilitated in their performance by the aversive stimulus.

Non-aversive Reinforcement. Since exposure to aversive stimuli is frequently considered as unwarranted within an institutional setting, it seems relevant to consider whether non-aversive stimuli might accomplish a similar increment in schizophrenic functioning. First, let us consider studies investigating the efficacy of verbal versus non-verbal, non-aversive reinforcement. MacDonald and Sheehan (1962) found that improved performances on the Purdue Pegboard and Wechsler subtests were elicited from schizophrenics by using concrete non-verbal reward (fudge). However, on verbal conditioning tasks, verbal individual encouragement proved most effective in facilitating performance (MacDonald and Sheehan, 1962). Kilberg (1962) also found that schizophrenics show improved verbal conditioning during verbal reward, rather than during reward with cigarettes.

In modifying complex behavior using operant conditioning methods, King, Armitage and Tilton (1960) found that non-verbal forms of response contingent reward (such as candy, cigarettes, and colored scenic slides) were more effective than verbal reward. Robertson (1961) concluded that concrete reward combined with verbal praise was most effective in manipulating the verbal behavior of chronic schizophrenics, but his failure to counterbalance experimental conditions lends some doubt to the credibility of these results. In commenting on these articles, Johannsen (1964) states that the majority of studies find verbal reward either ineffective in augmenting schizophrenic performance or incapable of sustaining a higher degree of proficiency.

It is necessary then to consider the particular effects of non-verbal, non-aversive reinforcement. King et al (1957) used cigarettes and candy as reinforcement for lever pressing in an operant conditioning experiment. They suggest that the reinforcements were too trivial for the controls and meaningless for the more disoriented group, but were quite effective for the acute schizophrenics. Mednick and Lindsley (1958) found no change in the operant lever pressing rate of chronic schizophrenics regardless of what type of reinforcer was used. Bullock and Brunt (1959) found money to be generally an ineffective reinforcer for schizophrenics, yet Pishkin, Smith and Lundy (1962) found money effective in reinforcing the verbal conditioning of "early chronic schizophrenics." Research on more complex phenomena was undertaken by King, Armitage and Tilton (1960). Their tasks ranged from simple operant conditioning to cooperative social responding. A sharp behavioral improvement was obtained using candy and cigarettes as reinforcement with schizophrenics.

Although punishment or aversive stimuli are generally accepted as being the most effective reinforcer for improving schizophrenic performance, some evidence does exist for utilizing non-verbal, non-aversive stimuli to manipulate schizophrenic behavior. The reinforcers of this nature which are most commonly used are money, cigarettes, and candy.

Concept Formation Tasks and Motivation

The problem of the effects of motivation upon concept formation tasks seems particularly relevant for the current developing interest in the area of concept formation. Previous studies regarding this problem have utilized tasks which frequently have introduced confounding factors in the stimulus presentation. For example, Heidbredder's (1946) tasks involved presenting the stimulus cues on memory drums, thereby introducing the effect of memory and obscuring the ability to form concepts. The often subtle effect of memory in forming concepts has frequently been a confound (Dominowski, 1965). The simultaneous method of presentation developed by Bruner, Goodnow and Austin (1956) which reduces the memory effect has rarely been utilized in motivational research. The studies which have attempted to delineate the effects of motivation on concept formation have employed a wide variety of stimulus cues. Siegman (1956) used WAIS subtests as a measure of concept formation, but problems with his methodology cause difficulty in interpreting his results. Sweetland and Childs-Quay (1958) used Heidbredder's techniques of presentation, obtaining a memory confound, yet they concluded that their "emotionally maladjusted" subjects performed better than the "adjusted" subjects on emotional concepts. Romanow (1958), in perhaps the most definitive experiment to date, utilized word concepts, by asking the subject to respond to a stimulus word with a concept. Scoring was based upon the frequency of the association of the response word. She found no significant differences between high and low anxiety groups when related to "concept dominance," that is the hierarchy of response frequency.

Buskirk (1961) used logical deductive tasks and figure analogies from Thurstone's Primary Mental Abilities Test. Each of 60 multiple choice problems were divided into four subtests differing in complexity, complexity defined as the number of propositions and conclusions for each problem. His measures of manifest anxiety were taken from interpretations of projective techniques and from a self-report inventory designed by the experimenter. The subjects were undergraduate students registered in psychology courses. Buskirk's results do not support his hypothesis that high anxiety performance will show increased intra-task interference, disorganization or ego defensiveness when the complexity of the conceptual task is increased. Some confounding factors seem to exist in Buskirk's study: an order effect of stimulus presentation; the use of only undergraduate college students; his methods of assessing anxiety level. Glucksberg (1962, 1964), using a problem solving task necessitating the manipulation of materials to complete an electric circuit, found that high drive impaired problem solving when response competition was high. He felt that the significant interaction of drive level and problem difficulty was in accord with Spence's theory of drive.

McGaughran and Moran's (1956) study clarifies the conceptual functioning of the chronic paranoid schizophrenic in comparison to non-psychiatric control subjects. Subjects were matched for age, education, and test intelligence level. Rapaport's modification of the Goldstein Object Sorting Test was used. Schizophrenics were able to function in a conceptual fashion without loss of abstracting ability; that is, no significant differences obtained between the chronic paranoid schizophrenics and the controls. However, the schizophrenics demonstrated a significant loss of the ability to communicate socially. The conceptual differences between schizophrenics and controls were related more closely with intellectual levels than with the presence or absence of schizophrenia. The schizophrenic deficit, then, seems to be one of debilitated social communication rather than any deficit in abstracting ability.

A study investigating concept formation, motivation, and schizophrenic thought processes, utilizing current findings in the techniques of assessing the ability to form concepts, seems quite relevent, particularly in light of the limited research in the area.

Chapter III. Method

Design and subjects. A 2x2x2x4 repeated measures factorial design was used with the following variables: (1) Classification (schizophrenic or non-schizophrenic inpatient), (2) Drive (high or low), (3) Reward (yes or no), (4) Complexity (one, two, three, or four irrelevant attributes on a concept formation task).

The subjects consisted of 40 schizophrenic and 40 non-schizophrenic inpatients living on small, non-locked units. Both subject groups were diagnosed as schizophrenic or non-schizophrenic by at least two independent sources within each patient's chart; e.g., admission note, psychiatric examination, psychological evaluation, consultant's report, etc. (See Table 1). The subjects were assigned to high and low drive groups in accordance with the data derived from the Taylor Manifest Anxiety Scale (See Table 2). Each subject was assigned randomly to reward or no reward experimental conditions. The groups were randomized so that significant differences between groups would be minimal on the basis of age, sex, marital status, education, previous hospitalizations and length of hospitalization. Subjects with the diagnosis of organic brain syndrome were not included. Also, no patient having had electroconvulsive therapy within the year prior to participating in the project was included in the final subject sample. Each cell contained ten subjects.

Half of the schizophrenic subjects were receiving phenothiazines, while one-fifth of the non-schizophrenics received phenothiazines (See Table 3). The actual effects of phenothiazines on learning are inconclusive, since there have not been conclusive, parametric investigations with controls on relevant variables. There does, however, seem to be consensus that learning is limited by chlorpromazine, the most commonly used phenothiazine (Hartlage, 1965). Chlorpromazine blocks the release of neurohormones by the autonomic nervous system and relieves anxiety and tension, in addition to depressing the reticular formation and the hypothalamus (Remmen et al.,1962). Chlorpromazine has also an anti-psychotic effect, reducing such symptoms as hallucinations, delusion and dissociation. Therefore, it must be recognized that half of the schizophrenic subjects are on medications which reduce the schizophrenic symptomatology. The medication, however, acts upon emotional, rather than cognitive, centers of the nervous system.

Stimulus Display. The concept formation task materials consist of four white posterboards, each containing a different number of 2½x4 inch cards drawn in colored ink with dark outlines.

Table 1

Frequency of Diagnostic Classifications for each Cell

		Frequency
Cell 1.	Non-schizophrenic, low drive, no reward.	
	Psychoneurotic depressive reaction	5
	Psychoneurotic anxiety reaction	2
	Passive-aggressive, passive-dependent personality	1
	Psychotic depressive reaction	1
	Schizoid personality	1
Cell 2.	Non-schizophrenic, low drive, reward.	
	Psychoneurotic depressive reaction	5
	Manic-depressive reaction, manic type	1
	Paranoid personality	1
	Passive-aggressive, passive-aggressive personality	1
	Passive-aggressive, passive-dependent personality	1
	Psychoneurotic anxiety reaction	1
Cell 3.	Non-schizophrenic, high drive, no reward.	
	Psychoneurotic depressive reaction	6
	Psychotic depressive reaction	2
	Emotionally unstable personality	1
	Passive-aggressive, passive-aggressive personality	1
Cell 4.	Non-schizophrenic, high drive, reward.	
	Psychoneurotic depressive reaction	3
	Psychoneurotic anxiety reaction	2
	Involutional psychotic reaction	1
	Paranoid personality	1
	Passive-aggressive, passive-dependent personality	1
	Psychotic depressive reaction	1
	Sociopathic personality	1
Cell 5.	Schizophrenic, low drive, no reward.	
	Schizophrenic reaction, acute undifferentiated type	4
	Schizophrenic reaction, chronic undifferentiated type	3
	Schizophrenic reaction, paranoid type	2
	Schizophrenic reaction, schizo-affective type	1

Table 1 (Continued)

Cell 6. Schizophrenic, low drive, reward.

Schizophrenic reaction, paranoid type	5
Schizophrenic reaction, acute undifferentiated type	3
Schizophrenic reaction, chronic undifferentiated type	2

Cell 7. Schizophrenic, high drive, no reward.

Schizophrenic reaction, acute undifferentiated type	3
Schizophrenic reaction, paranoid type	3
Schizophrenic reaction, chronic undifferentiated type	2
Schizophrenic reaction, schizo-affective type	2

Cell 8. Schizophrenic, high drive, reward.

Schizophrenic reaction, acute undifferentiated type	4
Schizophrenic reaction, paranoid type	3
Schizophrenic reaction, chronic undifferentiated type	2
Schizophrenic reaction, schizo-affective type	1

Table 2

Means Of Subject Groups For Taylor Manifest Anxiety Scale, Age, Education, Previous Hospitalizations, Days Hospitalized, SRA Verbal, SRA Non Verbal

	N	Taylor Manifest Anxiety Score	Age	Education	Previous Hospitalizations	Days Hospitalized	SRA Verbal	SRA Non Verbal
Non Schizophrenic								
Low Drive								
No Reward	10	18.4	30.00	13.40	.60	87.20	65.90	33.40
Reward	10	18.6	28.90	13.20	1.10	54.80	72.30	64.50
High Drive								
No Reward	10	36.7	26.70	13.30	.70	51.90	68.40	49.40
Reward	10	35.3	28.30	13.20	1.10	63.80	75.90	69.50
Schizophrenic								
Low Drive								
No Reward	10	16.5	25.20	14.10	.70	119.40	66.90	40.90
Reward	10	15.2	24.20	13.10	.90	80.20	71.70	37.80
High Drive								
No Reward	10	33.9	23.80	13.70	1.30	105.50	63.00	60.40
Reward	10	32.4	24.10	13.00	1.30	58.00	58.70	50.70

The cards were placed on each board in an ordered fashion. These displays consisted of the following attributes and values. Board I: 8 cards differing in (a) shape - square or triangle; (b) size - large or small; (c) color - red or blue. Board II: 16 cards differing in (a) shape; (b) size; (c) color; (d) number - one or two. Board III: 32 cards differing in (a) shape; (b) size; (c) color; (d) number; (e) border - one or two. Board IV: 64 cards differing in (a) shape; (b) size; (c) color; (d) number; (e) border; (f) design - solid or striped. Any two of these attributes were relevant to a given concept formation problem. That is, the problems varied in complexity from two relevant attribute and one irrelevant attribute (eight instances) problems to two relevant attribute and four irrelevant attribute (64 instances) problems. The four boards were presented in random order. The relevant concepts were predetermined in a random fashion, so as to avoid consistent presentation of inherently easy or difficult problems. Each subject was given one concept formation problem on each board, so that each subject attempted four problems.

Concept Formation Task. Any two, of the six possible attributes were relevant in each concept formation problem. The problems then varied in complexity from two relevant attribute and one irrelevant attribute (eight instances) problems to two relevant attribute and four irrelevant attribute (64 instances) problems. The relevant attributes were predetermined by randomly assigning the possible combinations of attributes.

Great care was taken to establish a fairly comfortable interpersonal relationship between subject and experimenter. The experimenter met with each subject at least three times during a two week period prior to the testing session. Before testing began, a minimum of 15 minutes was spent chatting with each subject, exploring his discomfort in the experimental situation, and discussing his expectations about the experiment. The instructions were given in an informal, conversational fashion that consistently dealt with the following specific topics. The informal presentation was necessary in order to continue the rapport already fairly well established with each subject. First, the attributes and levels were explained. Second, the arrangement of instances on the board were described, in addition to how several instances can be grouped together using only two attributes. Third, the task was then explained as finding "the combination of two properties (attributes) which is the right answer." Fourth, the method of finding the correct combination was explained: the examiner indicates one instance containing the two relevant attributes; the subject then chooses another instance; the examiner then indicates whether or not that instance also contains the two relevant attributes; the subject makes a guess about which two attributes he thinks are correct; if his guess is incorrect he chooses another instance.

The process continues until the subject finally guesses the correct two attributes.

Palmar Sweat Index. The Palmar Sweat Index measures the autonomic activity evident via the sweating on the palmar surface of the fingertips. (Brutton, 1963). The subject's finger was covered with a ferric chlorideacetone solution and pressed against a 35-millimeter film impregnated with tannic acid, for thirty seconds at one-half pound pressure. The resulting fingerprints varied in the density of the ink formed by the combination of the chemicals and sweat. A Lab-Line Sudorimeter was used for this procedure. A circular area approximately three-sixteenths of an inch in diameter was located around the center whorl of each fingerprint. Using a Lab-Line Densitometer, the amount of light from a constant source passing through that circular area fell upon a photosensitive cell. The density of the print was then registered in milliamperes. The instrument and its mechanics was explained to each subject, in order to reduce the subject's anxiety in being confronted with a strange instrument.

Procedure. In the first testing session, subjects were given the Taylor Manifest Anxiety Scale in a group setting of approximately thirty patients. Subjects were then selected on the basis of high and low MAS groups and on two concurrent diagnoses of schizophrenia or nonschizophrenia. The initial thirty subjects selected were given both the concept formation task and the SRA Verbal and Non-Verbal Tests in order to determine the minimal level of intelligence necessary to complete the concept formation task. A lower limit regarding SRA scores and education was established for the remainder of the subjects: 12 years of education and scores in the 15th percentile or higher. In the second testing session, all remaining subjects were administered the Palmar Sweat Index, the Concept Formation Task, and the SRA Tests.

The second session consisted of the following. Palmar sweat measurements were taken: three adaptation prints and one print during the first thirty seconds of the presentation of each concept formation board. The concept formation task was explained after presentation of the first board. The subjects in the reward condition were told of the reward, which was three cigarettes for completing each problem. Twelve cigarettes, the maximum reward, were placed in plain sight between the subject and the board during concept formation tasks. Finally, each subject completed the SRA Verbal and Non-Verbal Forms. These tests are brief, self-administered and indicate a gross level of intellectual functioning. The experimenter was unaware of the schizophrenic or drive classifications of the subjects during testing.

Chapter IV. Findings

Subject distribution

Because the subjects were assigned to cells according to diagnostic classification (non-schizophrenic and schizophrenic) and drive level (high and low), it is imperative that differences between cell samples be evaluated. Table 2 describes the subject sample along the dimensions of The Taylor Manifest Anxiety Scale, age, years of education, days hospitalized, the number of previous hospitalizations, SRA Verbal and Non-verbal scores. Using Duncan Multiple Range Tests (Edwards, 1962), no significant differences obtained for age, education or for number of previous hospitalizations. A significant difference occurred between high and low drive groups on the Taylor Manifest Anxiety Scale at $\underline{p} < .001$. There was a significant difference ($\underline{p} < .05$) for days hospitalized between the schizophrenic-high drive-no reward group and the following cells: non-schizophrenic-high drive-no reward; non-schizophrenic low drive-reward; and schizophrenic-high drive-reward. These significant differences are attributed to one patient who was hospitalized 463 continuous days prior to testing.

Measures of intellectual functioning were included in the study in order to partial out possible differences in intellectual level which could confound the results. Table 2 describes the low correlations between the dependent variables and the verbal and non-verbal intelligence scores. No significant differences obtained between cells on verbal intelligence as measured by the SRA Verbal Form. However, for the SRA Non-verbal Form, the higher scores in the non-schizophrenic-high drive-reward group differed from the lower scores in the non-schizophrenic-low drive-no reward group at the .05 level (see Table 3).

Psychotropic medications were prescribed for 57.5 percent of the subjects (see Table 4). A chi square test for k independent samples (Seigel, 1956) was done in order to discover whether any significant differences existed between groups regarding the frequency of certain prescribed medications. In addition to a no drug category, medications were grouped as follows: (1.) phenothiazines; (2.) benzodiazepines; (3.) dibenzazepines. There were no significant differences in the use of medications between high and low drive groups nor between reward and no reward groups. The schizophrenic subjects did receive significantly more phenothiazines than the non-schizophrenic subjects, $\underline{X}^2(3) = 9.17$, $\underline{p} < .05$).

Table 3

Correlations of Verbal and Non-Verbal Intelligence Scores With The Dependent Variables

	Verbal	Non-Verbal
Focusing Strategy	.13	.05
Scanning Strategy	-.07	-.07
Untenable Hypotheses	-.15	-.16
Choices	-.07	-.07
Time	-.13	-.14
Perceptual Inference Errors	-.19	-.18
Palmar Sweat Index	.02	-.06

Table 4

Frequency of Drugs Prescribed
For Each Cell

	Pheno-thiazines	Benzo-diazepines	Dibenza-zepines	No Drugs
Non Schizophrenic				
Low Drive				
No Reward	2	0	1	7
Reward	4	1	4	1
High Drive				
No Reward	1	1	2	6
Reward	1	3	1	5
Schizophrenic				
Low Drive				
No Reward	4	0	0	6
Reward	5	1	0	4
High Drive				
No Reward	6	1	1	2
Reward	5	0	2	3

Dependent Variables

The dependent variables on the concept formation task were: (1) focusing strategy (Laughlin, 1966); (2) scanning strategy (Laughlin, 1966); (3) untenable hypotheses (Laughlin, 1966); (4) card choices to solution; (5) time to solution; (6) perceptual inference errors (Cahill & Hovland, 1960); (7) the palmar sweat index (Haywood & Spielberger, 1966).

Each dependent variable was evaluated using a 2x2x2x4 repeated measures analysis of variance. The repeated measures were for the four concept formation problems presented. Two analyses of variance were done for each dependent variable. First, the repeated measures were considered in terms of increasing problem complexity, with problems rank ordered according to the number of irrelevant attributes. Second, the repeated measures were considered in terms of the order of the presentation; ie., for successive problems. The analysis was done for successive problems in order to determine whether an order effect existed which may have confounded the complexity. In the tables which present the analyses of vaiance, there is a summary for effects between subjects and two summaries for effects within subjects, one for complexity and one for successive problems. The between subjects data was the same for both complexity and successive problems, since the data is obtained for between groups by summing across problems.

The Duncan Multiple Range Test was used to determine which conditions contributed to the significant effects.

Focusing strategy. Focusing strategy involves the testing of the relevance of a particular attribute to the correct hypothesis. In focusing, the subject selects an instance which differs from the initial positive instance in one or more attributes. Scanning strategy, on the other hand, involves testing specific hypotheses until the correct one is found. These strategies were scored according to a system developed by Laughlin (1966). The criteria for focusing strategy can be summarized in three rules. Rule one: each card choice must obtain information on one new attribute. This rule is satisfied if the card choice alters only one attribute not previously proven irrelevant, or, when more than one attribute is altered, the instance is positive, or the ambiguous information is correctly resolved on the next card choice by altering only one attribute. Rule two: the hypothesis had to be tenable with the information available. Rule three: the hypothesis could not be a repetition of a previously given hypothesis. The number of instances of focusing is divided by the total number of card choices to arrive at a focusing score within the range of .00 to 1.00.

No significant effects occurred between subjects for focusing strategy (see Tables 5, 6 and 7). A main effect for the complexity of problems within subjects was significant, F (3, 216) = 20.71, $p < .001$ (see Tables 5 and 7). The concept formation tasks will be referred to as problems one through four, according to the number of irrelevant attributes each possesses, for complexity and as the first through fourth problems for successive problems. Problem one differed from problem 2 (two irrelevant attributes) at the .01 level, from problems 3 and 4 at the .001 level. Problems two and three and problems three and four were not significantly different from each other. Problem two differed from problem four at the .05 level. That is, as problems became more complex, less focusing occurred. The linear trend of this complexity effect is significant, $\underline{F}$ (1, 216) = 33.41, $\underline{p} < .001$. A significant drive x reward x complexity interaction obtained, $\underline{F}$ (3, 216) = 3.01, $\underline{p} < .05$ (see Tables 5 and 7 and Figure 1). Significant differences between subject groups occurred only on problem four, the most complex task, using the Duncan Multiple Range Test. Low drive-no reward subjects performed more poorly than low drive-reward subjects at the .05 level and more poorly than high drive-no reward subjects at the .01 level. High drive-no reward, high drive-reward, and low drive-reward subjects did not differ significantly from each other. For successive problems no significant effects occurred.

Table 5

Means For Focusing Strategy With
Complexity As Repeated Measure

	Complexity (Irrelevant Attributes)				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	.87	.71	.75	.39	2.72
Reward	.87	.75	.64	.64	2.90
High Drive					
No Reward	.90	.75	.68	.74	3.07
Reward	.97	.85	.61	.48	2.91
Schizophrenic					
Low Drive					
No Reward	.82	.69	.74	.36	2.61
Reward	.87	.69	.48	.58	2.62
High Drive					
No Reward	.95	.67	.87	.61	3.10
Reward	.85	.69	.55	.46	2.55

Table 6

Means For Focusing Strategy With
Successive Problems As Repeated Measures

	Successive Problems				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	.79	.56	.65	.72	2.72
Reward	.82	.67	.79	.61	2.89
High Drive					
No Reward	.70	.91	.72	.73	3.06
Reward	.86	.66	.71	.69	2.92
Schizophrenic					
Low Drive					
No Reward	.78	.65	.47	.72	2.62
Reward	.86	.43	.63	.70	2.62
High Drive					
No Reward	.67	.81	.88	.74	3.10
Reward	.66	.66	.60	.63	2.55

Table 7

Analysis of Variance For Focusing Strategy With Complexity And With Successive Problems As Repeated Measures †

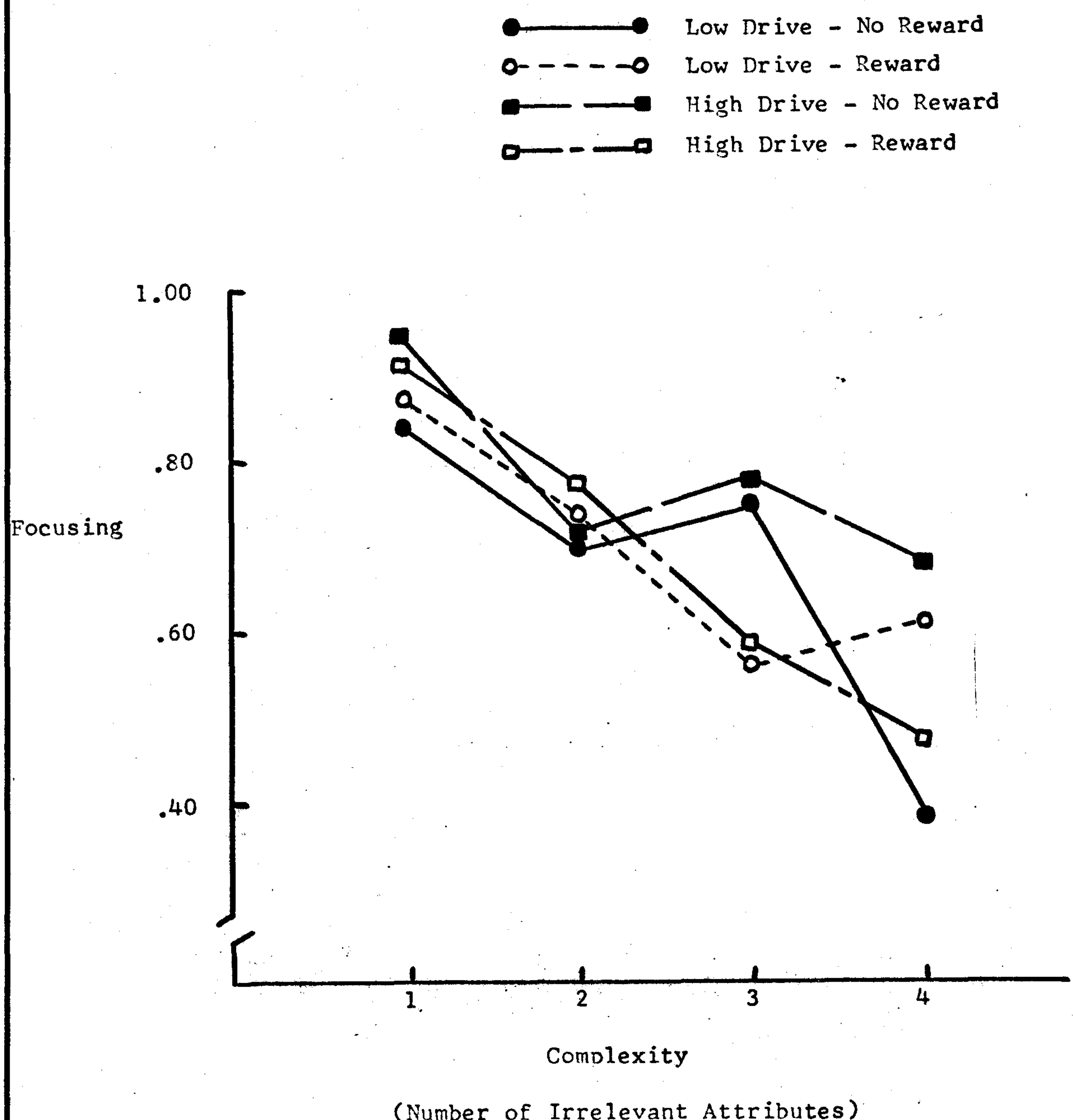
Source	df	SS	MS	F
Classification (C)	1	.16	.16	1.64
Drive (D)	1	.18	.18	1.86
Reward (R)	1	.08	.08	.85
C x D	1	.00	.00	.01
C x R	1	.10	.10	.97
D x R	1	.25	.25	2.52
C x D x R	1	.01	.01	.15
Error (Between Subjects)	72	7.07	.10	
Complexity (Co)	3	5.16	1.72	20.71***
Co x C	3	.06	.02	.23
Co x D	3	.04	.01	.15
Co x R	3	.66	.22	2.65
Co x C x D	3	.15	.05	.60
Co x C x R	3	.14	.04	.54
Co x D x R	3	.75	.25	3.01*
Co x C x D x R	3	.08	.03	.33
Error (Within Subjects)	216	17.93	.08	
Problems (P)	3	.47	.16	1.53
P x C	3	.07	.02	.23
P x D	3	.81	.27	2.63
P x R	3	.43	.14	1.39
P x C x D	3	.29	.10	.94
P x C x R	3	.06	.02	.21
P x D x R	3	.33	.11	1.06
P x C x D x R	3	.41	.14	1.34
Error (Within Subjects)	216	22.10	.10	

† Note that analyses of variance with complexity and successive problems as repeated measures have been combined in this table.

* $p < .05$
*** $p < .001$

Figure 1

Drive x Reward x Complexity Interaction
For Focusing Strategy



<u>Scanning strategy</u>. Scanning strategy involves the testing of specific hypotheses until the correct one is found. Scoring for scanning involves tallying all the specific hypotheses disproved by a subject's guesses, then dividing by the number of correct card choices. The most efficient way to score for scanning entails making a chart, arranged by hypotheses, of those concepts eliminated by selection of a positive instance and those eliminated by selection of a negative instance. If a selected card is positive, all concepts differing on the given and selected card are eliminated. If the selected card is negative, all identical concepts are eliminated. The number of concepts thus eliminated is added to the number eliminated by direct hypothesis. The total is then divided by the total number of card choices. The scanning score is the average number of concepts eliminated on each card choice.

There was a significant drive x reward interaction for scanning, $\underline{F}(1, 72) = 6.41$, $\underline{p} < .025$ (see Tables 8, 9 and 10 and Figure 2). The significance of the interaction was accounted for by the debilitated performance of the high drive group under the reward condition ($\underline{p} < .05$) and by the difference in performance between the low and high drive groups under the no reward condition ($\underline{p} < .01$). There was no significant difference between drive groups under the reward condition.

In the analysis of repeated measures for complexity, a significant effect for complexity did occur, F (3, 216) = 22.41, $p < .001$ (see Tables 8 and 10). Problem one differed from problem two at the .05 level and from problems three and four at $p < .001$. Problem two differed from problems three and four at $p < .001$. Problems three and four were not significantly different. Then, as problems increased in complexity, there was more scanning strategy used. Trend analysis showed this effect to be linear, F (1, 216) = 63.92, $p < .001$.

A triple interaction existed for drive x reward x complexity, F (3, 216) = 5.23, $p < .01$ (see Tables 8 and 10 and Figure 3). Significant differences between subject groups occurred only on problem four, the most complex task. The low drive-no reward subjects were found to perform more poorly than low drive-reward subjects ($p < .05$) and than high drive-no reward subjects ($p < .001$). No significant differences obtained between low drive-no reward and high drive-reward subjects nor between low drive-reward and high drive-reward subjects. However, the low drive-reward group performed significantly more poorly than the low drive-no reward group ($p < .05$).

Table 8

Means For Scanning Strategy With
Complexity As Repeated Measure

	Complexity (Irrelevant Attributes)				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	1.85	2.75	4.01	3.00	11.61
Reward	1.78	2.50	3.48	4.40	12.16
High Drive					
No Reward	2.05	2.75	3.21	5.44	13.45
Reward	1.95	3.05	3.52	3.11	11.63
Schizophrenic					
Low Drive					
No Reward	1.68	2.37	3.23	2.42	9.70
Reward	2.25	2.24	3.28	3.46	11.23
High Drive					
No Reward	2.30	2.40	3.75	4.31	12.76
Reward	2.00	2.15	2.87	3.00	10.02

Table 9

Means For Scanning Strategy With
Successive Problems As Repeated Measure

	Successive Problems				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	3.00	2.90	2.96	2.75	11.61
Reward	3.29	3.08	3.42	2.38	12.17
High Drive					
No Reward	3.85	3.65	3.52	2.43	13.45
Reward	3.31	2.34	2.57	3.41	11.63
Schizophrenic					
Low Drive					
No Reward	2.39	2.90	1.89	2.53	9.71
Reward	3.56	1.73	3.03	2.90	11.22
High Drive					
No Reward	2.82	2.80	3.68	3.46	12.76
Reward	2.60	2.48	2.50	2.45	10.03

Table 10

Analysis of Variance For Scanning Strategy With Complexity And With Successive Problems As Repeated Measures

Source	df	SS	MS	F
Classification (C)	1	8.19	8.19	3.83
Drive (D)	1	3.14	3.14	1.47
Reward (R)	1	1.94	1.94	.91
C x D	1	.09	.09	.04
C x R	1	.00	.00	.00
D x R	1	13.70	13.70	6.41*
C x D x R	1	1.11	1.11	.52
Error (Between Subjects)	72	153.91	2.14	
Complexity (Co)	3	144.19	48.06	22.41***
Co x C	3	7.64	2.55	1.19
Co x D	3	6.74	2.25	1.05
Co x R	3	1.42	.47	.22
Co x C x D	3	1.41	.47	.22
Co x C x R	3	1.50	.50	.23
Co x D x R	3	33.65	11.22	5.23**
Co x C x D x R	3	6.66	2.22	1.04
Error (Within Subjects)	216	463.23	2.14	
Problems (P)	3	6.55	2.18	.77
P x C	3	4.99	1.66	.59
P x D	3	.51	.17	.06
P x R	3	7.62	2.54	.90
P x C x D	3	5.95	1.98	.70
P x C x R	3	4.18	1.39	.49
P x D x R	3	10.42	3.47	1.23
P x C x D x R	3	16.57	5.52	1.96
Error (Within Subjects)	216	609.63	2.82	

* $p < .025$
** $p < .01$
*** $p < .001$

Figure 2

Drive x Reward Interaction
For Scanning Strategy

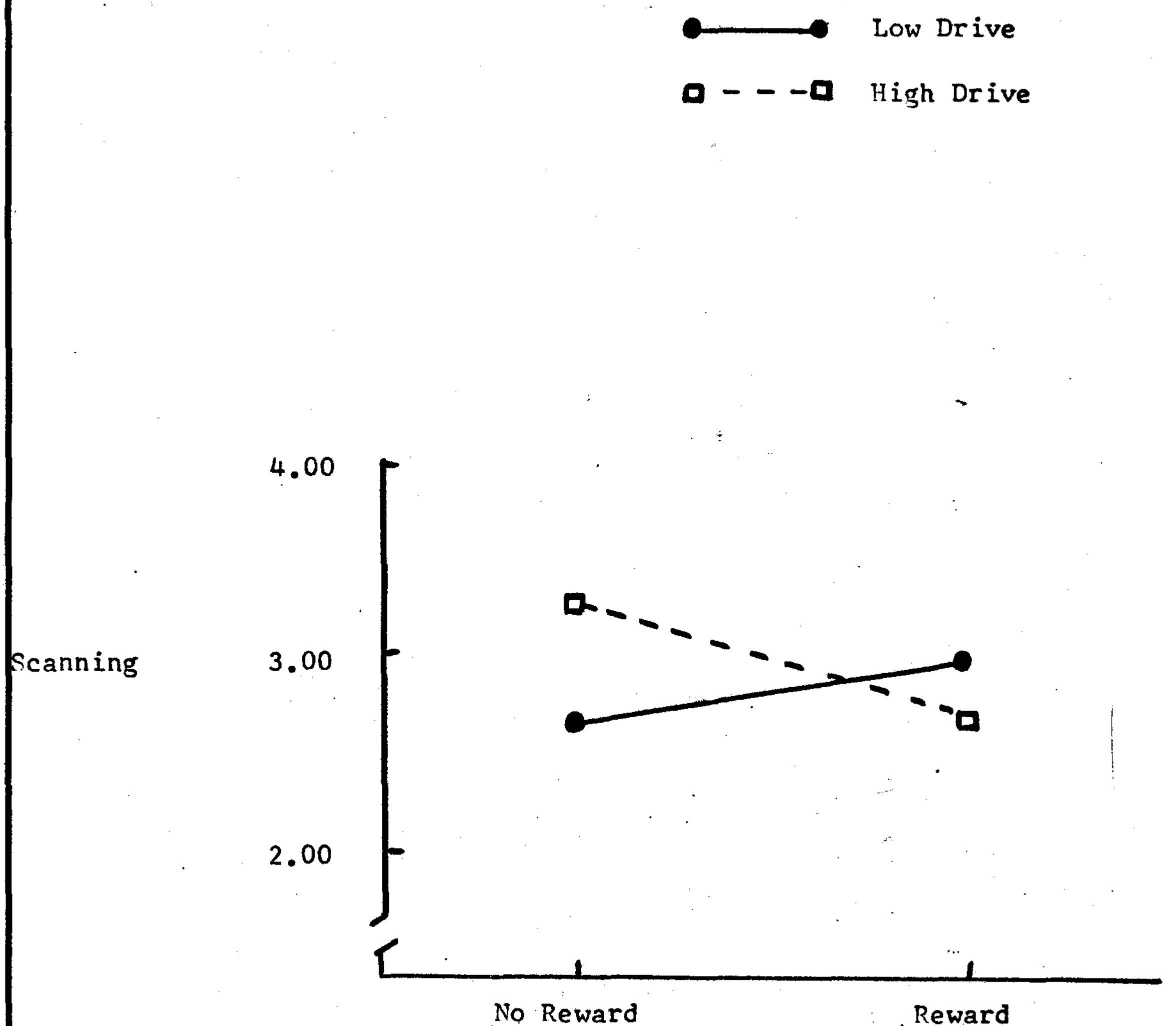
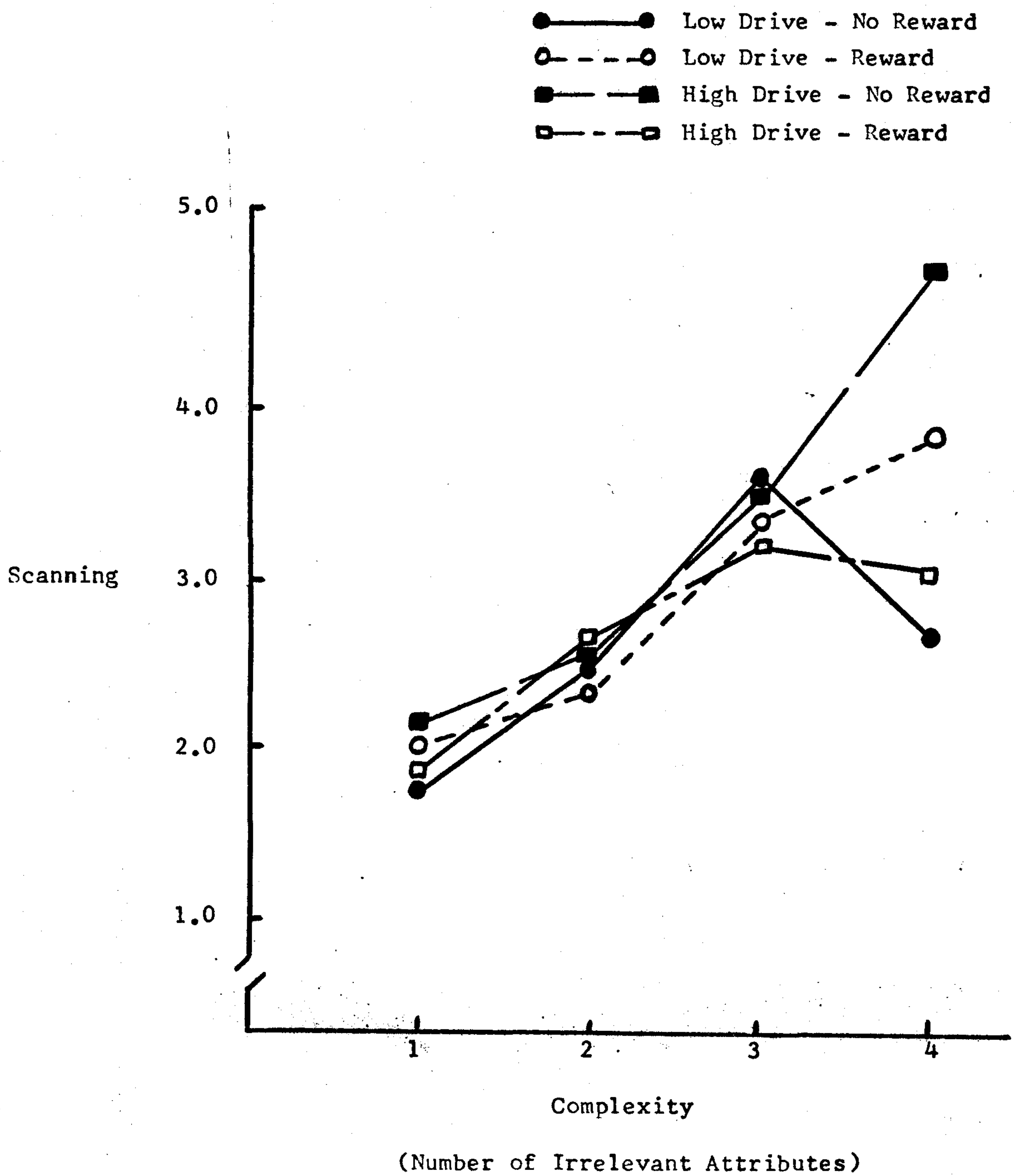


Figure 3

Drive x Reward x Complexity Interaction
For Scanning Strategy



Untenable hypotheses. The number of untenable hypotheses which each subject submitted was obtained by checking each hypothesis against those already given for (a.) Inconsistencies with the information already given and (b.) for repetition of previous hypotheses (Laughlin, 1966).

No significant effects occurred between subjects for untenable hypotheses (see Tables 11, 12 and 13). The analysis of the within subject variance revealed a significant effect for the complexity of the concept formation tasks, $F(3, 216) = 24.20$, $p < .001$ (see Tables 11 and 13). Problem one differed from problem two at $p < .05$, from problem three at $p < .01$, and from problem four at $p < .001$. Problem two did not differ significantly from problem three, but differed at the .001 level from problem four. Problem three also differed from problem four at $p < .001$. As complexity increased more untenable hypotheses were submitted. The linear trend of the effect was significant at $p < .001$, $F(1, 216) = 63.54$. A significant double interaction occurred for reward and complexity when analyzing the repeated measures for complexity, $F(3, 216) = 2.92$, $p < .05$ (see Tables 11, 12 and 13 and Figure 4). No significant differences obtained for the first three levels of complexity, but on the most complex task, reward groups performed significantly better than no-reward groups ($p < .05$).

Table 11

Means For Untenable Hypotheses With Complexity As Repeated Measure

	Complexity (Irrelevant Attributes)				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	.30	1.00	1.20	5.60	8.10
Reward	.40	1.00	1.40	1.60	4.40
High Drive					
No Reward	.20	.70	2.00	1.80	4.70
Reward	.10	.30	1.80	2.90	5.10
Schizophrenic					
Low Drive					
No Reward	.40	1.30	.70	5.60	8.00
Reward	.30	1.90	2.60	2.50	7.30
High Drive					
No Reward	.10	1.00	.60	2.00	3.70
Reward	.10	1.40	2.10	3.20	6.80

Table 12

Means For Untenable Hypotheses With
Successive Problems As Repeated Measure

	Successive Problems				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	.90	1.70	1.90	3.60	8.10
Reward	.90	1.50	.50	1.50	4.40
High Drive					
No Reward	1.40	.30	1.00	2.00	4.70
Reward	.60	1.80	1.50	1.20	5.10
Schizophrenic					
Low Drive					
No Reward	1.40	1.20	3.90	1.50	8.00
Reward	.50	3.70	1.00	2.10	7.30
High Drive					
No Reward	1.20	.80	.30	1.40	3.70
Reward	.70	1.60	2.40	2.10	6.80

Table 13

Analysis of Variance For Untenable Hypotheses With Complexity And With Successive Problems As Repeated Measures

Source	df	SS	MS	F
Classification (C)	1	3.83	3.83	.68
Drive (D)	1	17.58	17.58	3.14
Reward (R)	1	.25	.25	.04
C x D	1	1.38	1.38	.25
C x R	1	10.15	10.15	1.81
D x R	1	19.50	19.50	3.48
C x D x R	1	.03	.03	.00
Error (Between Subjects)	72	403.02	5.60	
Complexity (Co)	3	359.96	119.99	24.20***
Co x C	3	7.28	2.43	.49
Co x D	3	24.38	8.13	1.64
Co x R	3	43.46	14.49	2.92*
Co x C x D	3	2.93	.99	.20
Co x C x R	3	8.01	2.67	.54
Co x D x R	3	92.21	30.74	6.20***
Co x C x D x R	3	.93	.31	.06
Error (Within Subjects)	216	1071.08	4.96	
Problems (P)	3	39.41	13.14	2.01
P x C	3	12.08	4.03	.62
P x D	3	9.18	3.06	.47
P x R	3	39.06	13.02	2.00
P x C x D	3	11.78	3.93	.60
P x C x R	3	17.36	5.79	.89
P x D x R	3	42.66	14.22	2.18
P x C x D x R	3	30.03	10.01	1.54
Error (Within Subjects)	216	1408.68	6.52	

* $p < .05$
*** $p < .001$

Figure 4

Reward x Complexity Interaction
For Untenable Hypothesis

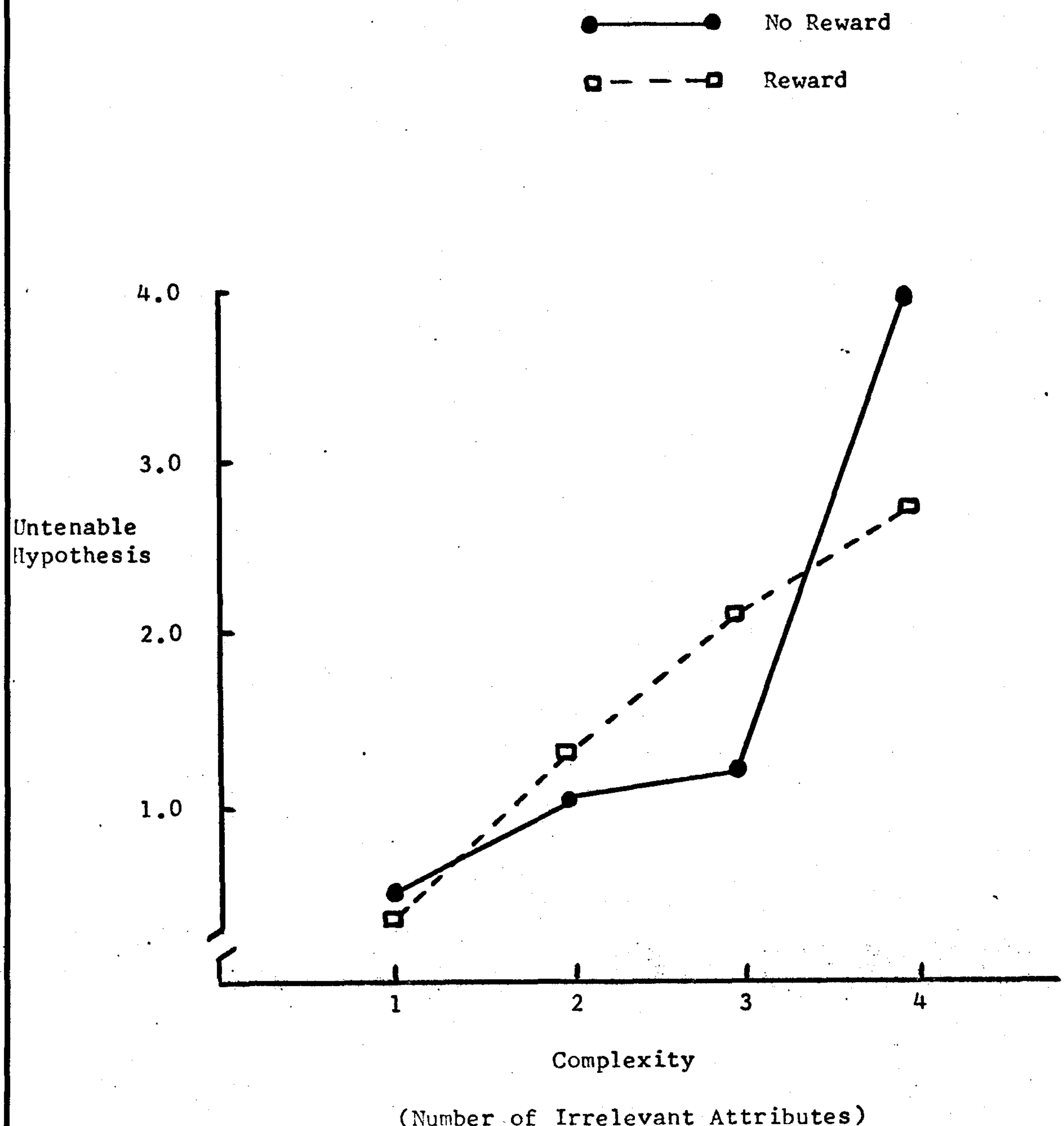
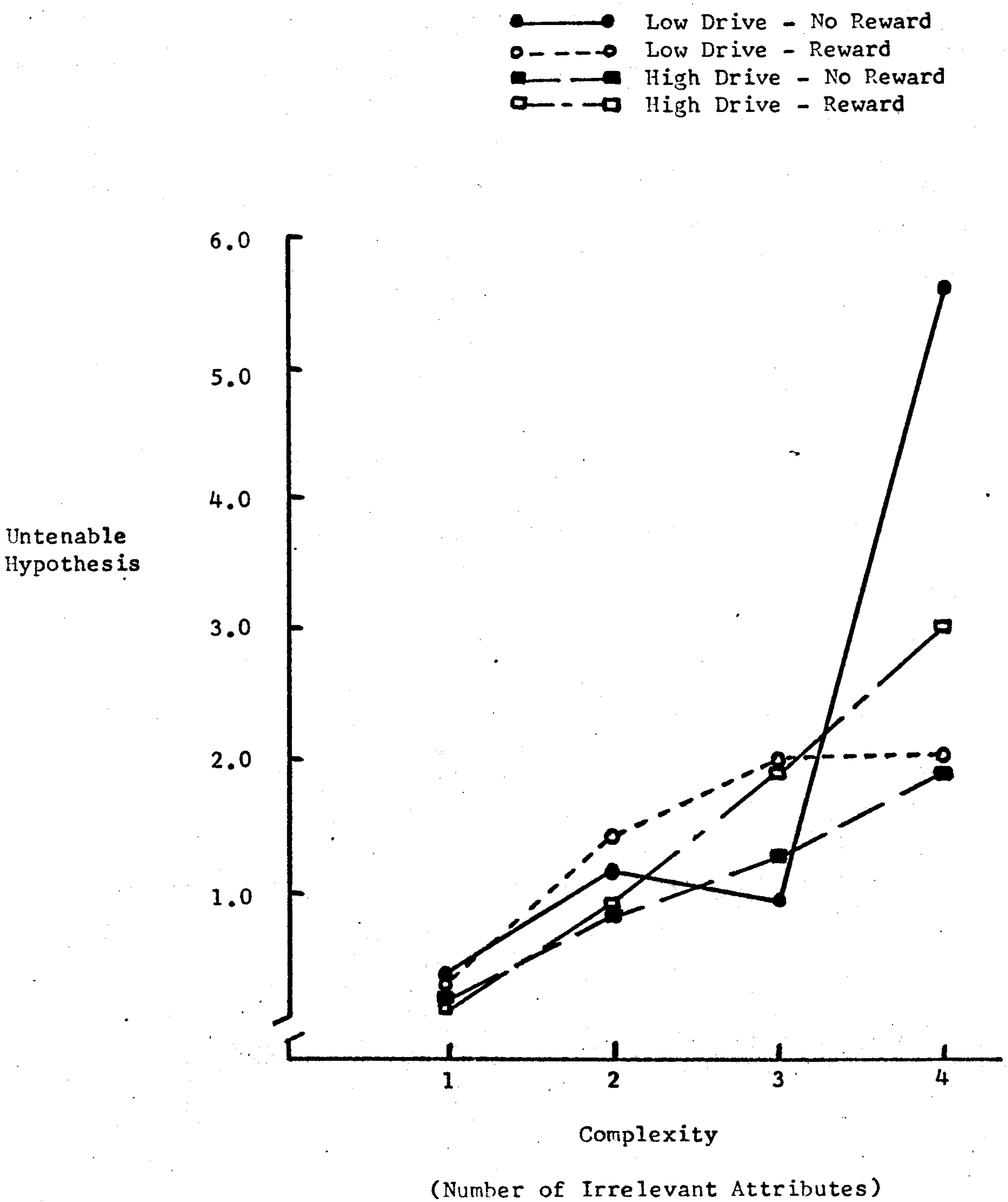


Figure 5

Drive x Reward x Complexity Interaction
For Untenable Hypothesis



A significant triple interaction also occurred for the complexity of tasks between drive, reward and complexity, F (3, 216) = 6.20, $p < .001$ (see Tables 11 and 13 and Figure 5). There were no significant differences between groups on the less complex problems one, two and three. On problem four, the low drive-no reward subjects performed significantly more poorly than low drive-reward subjects and high drive-no reward subjects ($p < .001$) and also more poorly than high drive-reward subjects ($p < .01$). The low drive-reward, high drive-no reward, and the high drive-reward subjects did not differ significantly from each other. There were no significant effects for successive problems.

Choices. Scores for choices to solution were obtained by totalling the number of card choices. No significant differences occurred between subjects (see Tables 14, 15 and 16). A significant effect for complexity did obtain, F (3, 216) = 34.30, $p < .001$ (see Tables 14 and 16). Problem one differed from problem two at $p < .01$, from problem three and four at $p < .001$. Problem two differed from problem three at $p < .05$ and from problem four at $p < .001$. Problem three differed from problem four at $p < .001$. As complexity increased, more card choices were made. The linear trend was significant F (1, 216) = 100.49, $p < .001$.

A significant triple interaction occurred for drive x reward x complexity, *F* (3, 216) = 5.57, *p* $\angle$.005 (see Tables 14 and 16 and Figure 6). No significant differences obtained between groups for problems one, two and three. On the most complex problem, low drive-no reward subjects performed significantly more poorly than low drive-reward subjects (*p* $\angle$.001), more poorly than high drive-reward subjects (*p* $\angle$.01) and more poorly than high drive-no reward subjects (*p* $\angle$.001). There were no significant differences between high drive-reward subjects and low drive-reward subjects, nor any significant differences between low drive-reward and high drive-no reward subjects. High drive-reward subjects did perform more poorly than high drive-no reward subjects (*p* $\angle$.05).

An effect for successive problems was significant at *p* $\angle$.05, *F* (3, 216) = 2.68 (see Tables 15 and 16). The first problem presented differed significantly from the last problem at the .05 level, fewer choices being made on the first than on the last problem. None of the other successive problems differed significantly from each other. The linear trend was significant at the .01 level, *F* (1, 216) = 6.90.

Table 14

Means For Choices With Complexity
As Repeated Measure

	Complexity (Irrelevant Attributes)				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	1.50	2.80	2.80	7.30	14.40
Reward	1.90	2.70	3.50	3.80	11.90
High Drive					
No Reward	1.50	2.20	4.30	3.40	11.40
Reward	1.70	1.90	3.80	5.50	12.90
Schizophrenic					
Low Drive					
No Reward	1.90	3.00	3.10	7.80	15.80
Reward	1.50	3.60	4.50	5.00	14.60
High Drive					
No Reward	1.20	2.70	2.70	4.30	10.90
Reward	1.20	3.30	3.80	5.50	13.80

Table 15

Means For Choices With
Successive Problems As Repeated Measure

	Successive Problems				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	2.20	3.40	3.70	5.10	14.40
Reward	2.70	3.50	2.30	3.40	11.90
High Drive					
No Reward	3.20	1.90	2.40	3.90	11.40
Reward	2.30	3.90	3.30	3.40	12.90
Schizophrenic					
Low Drive					
No Reward	3.30	2.80	6.20	3.50	15.80
Reward	1.70	5.80	3.20	3.90	14.60
High Drive					
No Reward	3.10	2.50	2.10	3.20	10.90
Reward	2.00	3.30	4.70	3.80	13.80

Table 16

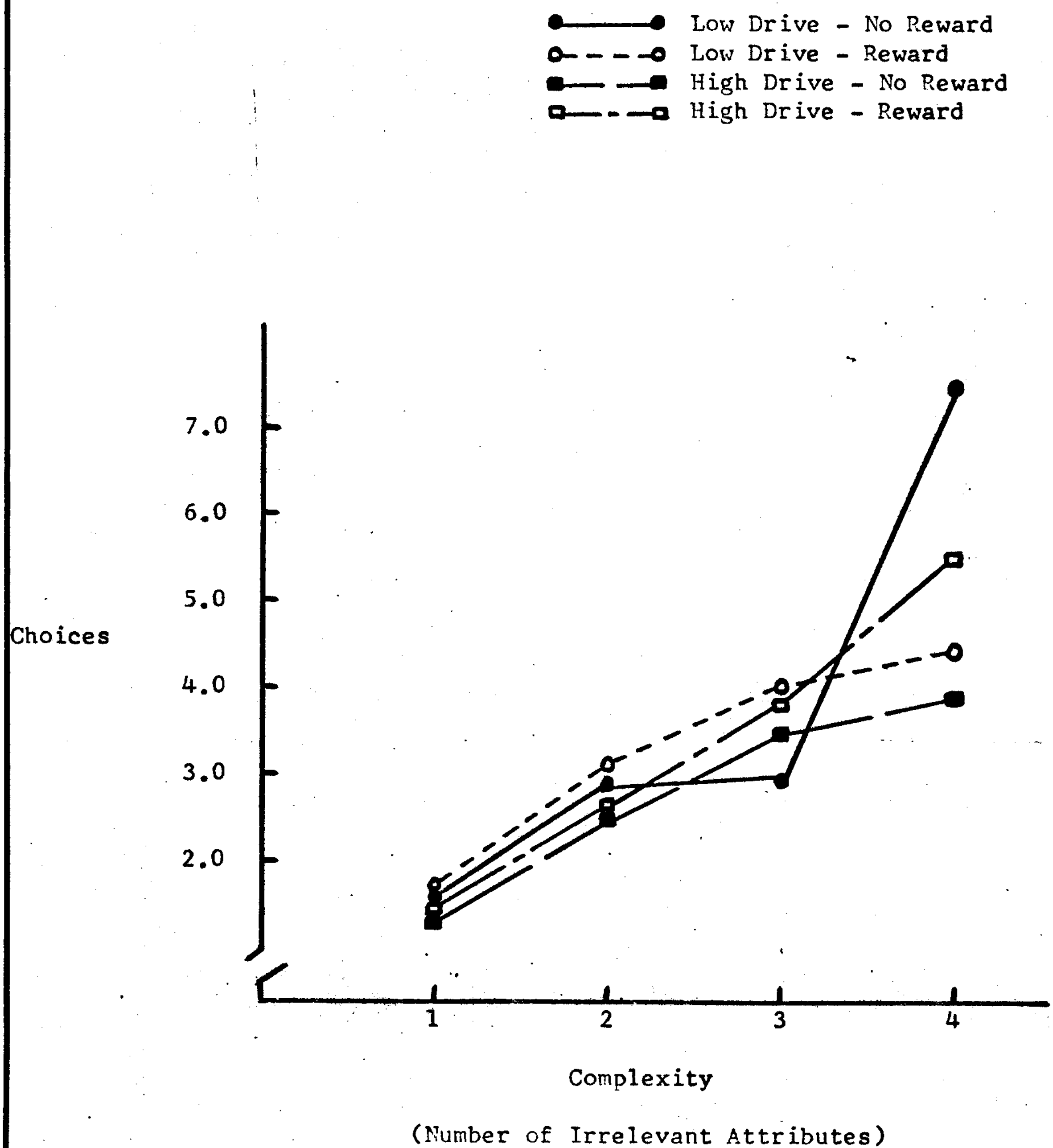
Analysis of Variance For Choices With Complexity
And With Successive Problems As Repeated Measures

Source	df	SS	MS	F
Classification (C)	1	6.33	6.33	1.14
Drive (D)	1	18.53	18.53	3.33
Reward (R)	1	.15	.15	.03
C x D	1	4.28	4.28	.77
C x R	1	2.28	2.28	.41
D x R	1	20.50	20.50	3.69
C x D x R	1	.00	.00	.00
Error (Between Subjects)	72	400.28	5.56	
Complexity (Co)	3	600.61	200.20	34.30***
Co x C	3	14.28	4.76	.82
Co x D	3	22.68	7.56	1.30
Co x R	3	21.06	7.02	1.20
Co x C x D	3	8.63	2.88	.49
Co x C x R	3	8.83	2.94	.50
Co x D x R	3	97.61	32.54	5.57**
Co x D x C x R	3	4.71	1.57	.29
Error (Within Subjects)	216	1260.83	5.84	
Problems (P)	3	64.98	21.66	2.68*
P x C	3	25.16	8.39	1.04
P x D	3	14.81	4.94	.61
P x R	3	58.18	19.39	2.40
P x C x D	3	7.06	2.35	.29
P x C x R	3	20.76	6.92	.86
P x D x R	3	61.08	20.36	2.52
P x C x D x R	3	40.38	13.46	1.66
Error (Within Subjects)	216	1746.82	8.09	

* $p < .05$
** $p < .005$
*** $p < .001$

Figure 6

Drive x Reward x Complexity Interaction
For Choices



Time. Time in seconds to solution was another dependent variable. No significant differences were evident between subjects (see Tables 17, 18 and 19). A significant effect for complexity did obtain, $F(3, 216) = 22.93$, $p < .001$ (see Tables 17 and 19). Problem one differed from problem two at $p < .01$ and from problems three and four at $p < .001$. Problem two did not differ significantly from problem three and differed from problem four at $p < .001$. Problem three differed from problem four at $p < .001$. As complexity increased, time also increased. The linear trend was significant at the .001 level, $F(1, 216) = 37.54$. A significant triple interaction resulted for drive x reward x complexity, $F(3, 216) = 2.71$, $p < .05$ (see Tables 17 and 19 and Figure 7). No significant differences occurred for problems one, two and three. On the most complex problem the low drive-no reward subjects demonstrated poorer performance ($p < .001$) than the other three groups among which there were no significant differences. No significant effects obtained within subjects for successive problems.

Perceptual inference errors. Perceptual inference errors (Cahill & Hovland, 1960) were defined in this dissertation as those which were inconsistent with information given on the immediately preceding two card selections or those which repeated either one of the two immediately preceding hypotheses. No between subjects effects obtained significance (see Tables 20, 21 and 22.

Table 17

Means For Time With Complexity
As Repeated Measure

	Complexity (Irrelevant Attributes)				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	86.70	291.50	282.50	787.10	1447.80
Reward	168.30	193.90	297.40	349.70	1009.30
High Drive					
No Reward	82.50	232.90	461.90	497.80	1275.10
Reward	132.30	155.10	372.50	496.10	1156.00
Schizophrenic					
Low Drive					
No Reward	107.70	267.40	291.80	692.60	1359.50
Reward	108.70	269.70	365.80	450.50	1194.40
High Drive					
No Reward	133.60	209.90	184.30	266.80	794.60
Reward	59.80	341.90	373.90	488.90	1264.50

Table 18

Means For Time With
Successive Problems As Repeated Measure

	Successive Problems				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	213.10	453.40	409.30	372.00	1447.80
Reward	316.50	302.20	158.30	232.30	1009.30
High Drive					
No Reward	308.70	192.10	267.40	506.90	1275.10
Reward	294.80	415.90	223.60	221.70	1156.00
Schizophrenic					
Low Drive					
No Reward	403.40	208.70	565.40	182.00	1359.50
Reward	122.00	533.60	272.80	266.00	1194.40
High Drive					
No Reward	230.40	141.60	231.90	190.70	794.60
Reward	183.40	372.40	443.90	264.80	1264.50

Table 19

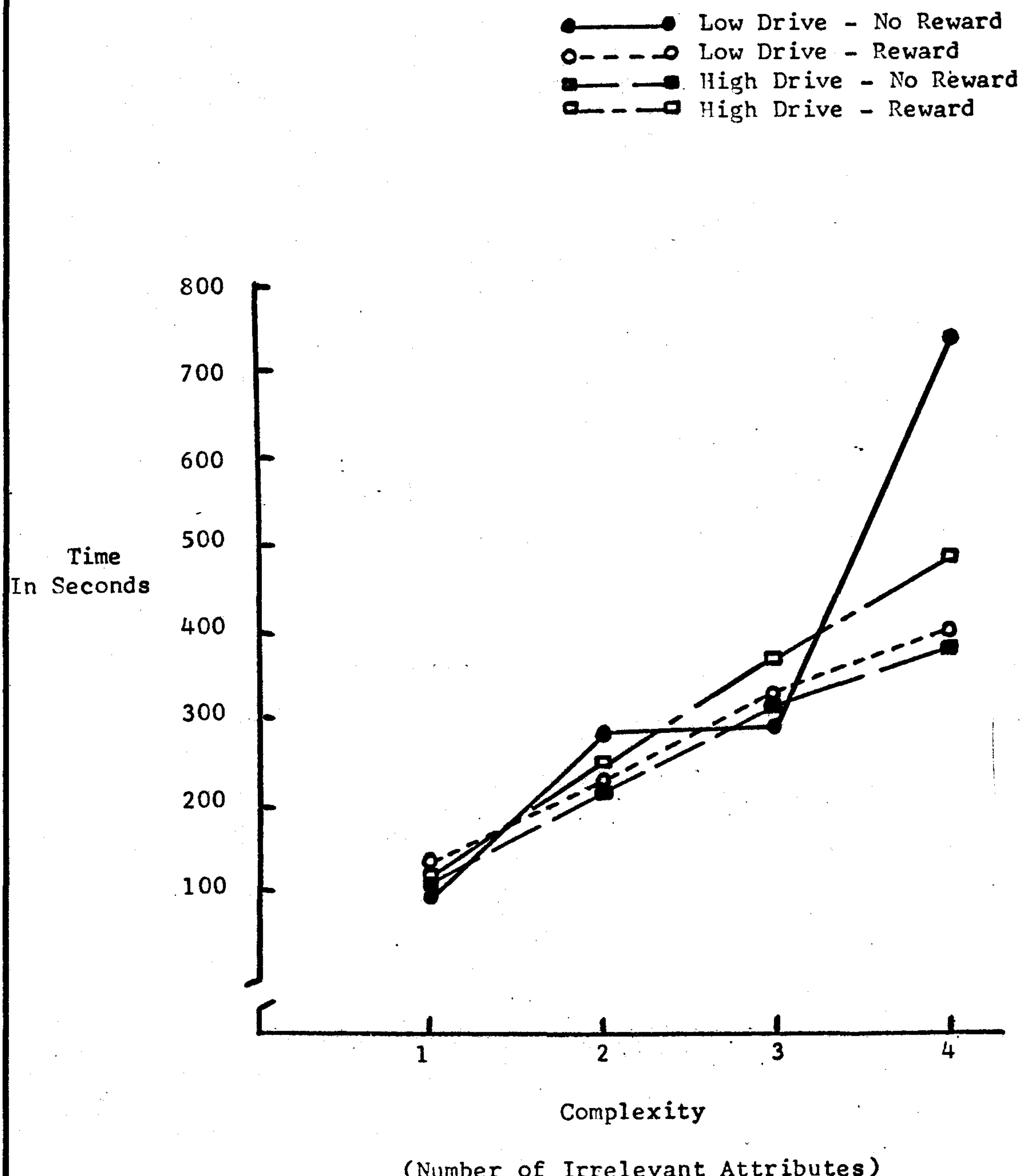
Analysis of Variance For Time With Complexity And Successive Problems As Repeated Measures

Source	df	SS	MS	F
Classification (C)	1	23667.00	23667.00	.19
Drive (D)	1	84760.00	84760.00	.69
Reward (R)	1	19971.00	19971.00	.16
C x D	1	68678.00	68678.00	.56
C x R	1	232415.00	232415.00	1.89
D x R	1	284649.00	284649.00	2.32
C x D x R	1	31130.00	31130.00	.25
Error (Between Subjects)	72	882770.00	122677.36	
Complexity (Co)	3	6511545.00	2170515.00	22.93***
Co x C	3	155145.00	51731.00	.55
Co x D	3	310310.00	103436.66	1.09
Co x R	3	294626.00	98208.67	1.04
Co x C x D	3	178769.00	59589.67	.63
Co x C x R	3	301816.00	100605.33	1.06
Co x D x R	3	770043.00	256681.00	2.71*
Co x C x D x R	3	47811.00	15937.00	.17
Error (Within Subjects)	216	20444109.00	94648.65	
Problems (P)	3	262321.00	87440.33	.74
P x C	3	527439.00	175813.00	1.49
P x D	3	186756.00	62252.00	.53
P x R	3	809955.00	269985.00	2.29
P x C x D	3	8731.00	2910.33	.02
P x C x R	3	759830.00	253276.66	2.15
P x D x R	3	494634.00	164878.00	1.40
P x C x D x R	3	532091.00	177363.66	1.51
Error (Within Subjects)	216	25432463.00	117742.88	

* $p < .05$
*** $p < .001$

Figure 7

Drive x Reward x Complexity Interaction
For Time



In the repeated measures analysis a significant effect occurred for complexity at the .001 level, $\underline{F}(3, 216) = 16.94$ (see Tables 20 and 22). Problem one differed significantly from problem two at $p < .01$ and from problems three and four at $p < .001$. Problem two did not differ significantly from problem three, but did differ from problem four at $\underline{p} < .001$. Problem three differed from problem four at the .01 level. As problems became more complex, perceptual inference errors increased in number. The linear trend was significant at .001, $\underline{F}\ (1, 216) = 50.52$. A significant triple interaction occurred for drive x reward x complexity, $\underline{F}(3, 216) = 7.90$, $\underline{p} < .001$ (see Tables 20 and 22 and Figure 8). None of the groups differed significantly on problems one, two and three. On problem four the low drive-no reward subjects performed more poorly than high drive-reward subjects ($\underline{p} < .05$) and more poorly than the high drive-no reward and low drive-reward subjects ($\underline{p} < .001$). The high drive-reward group did not differ significantly from the high drive-no reward subjects, but did differ from the low drive-reward group ($\underline{p} < .01$). The high drive-no reward subjects did not differ from the low drive-reward group. No effects obtained significance in the analysis for successive problems.

Palmar sweat index. The palmar sweat index score was the amount of change in milliamperes from the subject's basal level of palmar sweating to each finger. The basal level was defined as the level evident in the third adaptational measurement.

Table 20

Means For Perceptual Inference
Errors With Complexity As Repeated Measure

	Complexity (Irrelevant Attributes)				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	.20	1.00	.90	3.50	5.60
Reward	.40	.80	1.30	.90	3.40
High Drive					
No Reward	.20	.70	1.20	1.10	3.20
Reward	.10	.30	1.20	2.00	3.60
Schizophrenic					
Low Drive					
No Reward	.40	1.10	.50	3.50	5.50
Reward	.30	1.70	2.00	1.20	5.20
High Drive					
No Reward	.10	1.00	.80	1.10	3.00
Reward	.10	1.20	1.70	2.60	5.60

Table 21

Means For Perceptual Inference Errors
With Successive Problems As Repeated Measure

	Successive Problems				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	.70	1.10	1.50	2.30	5.60
Reward	.80	.90	.50	1.20	3.40
High Drive					
No Reward	.90	.30	.70	1.30	3.20
Reward	.30	1.20	1.20	.90	3.60
Schizophrenic					
Low Drive					
No Reward	1.00	1.00	2.20	1.30	5.50
Reward	.40	2.70	1.00	1.10	5.20
High Drive					
No Reward	1.10	.60	.30	1.00	3.00
Reward	.60	1.40	1.80	1.80	5.60

Table 22

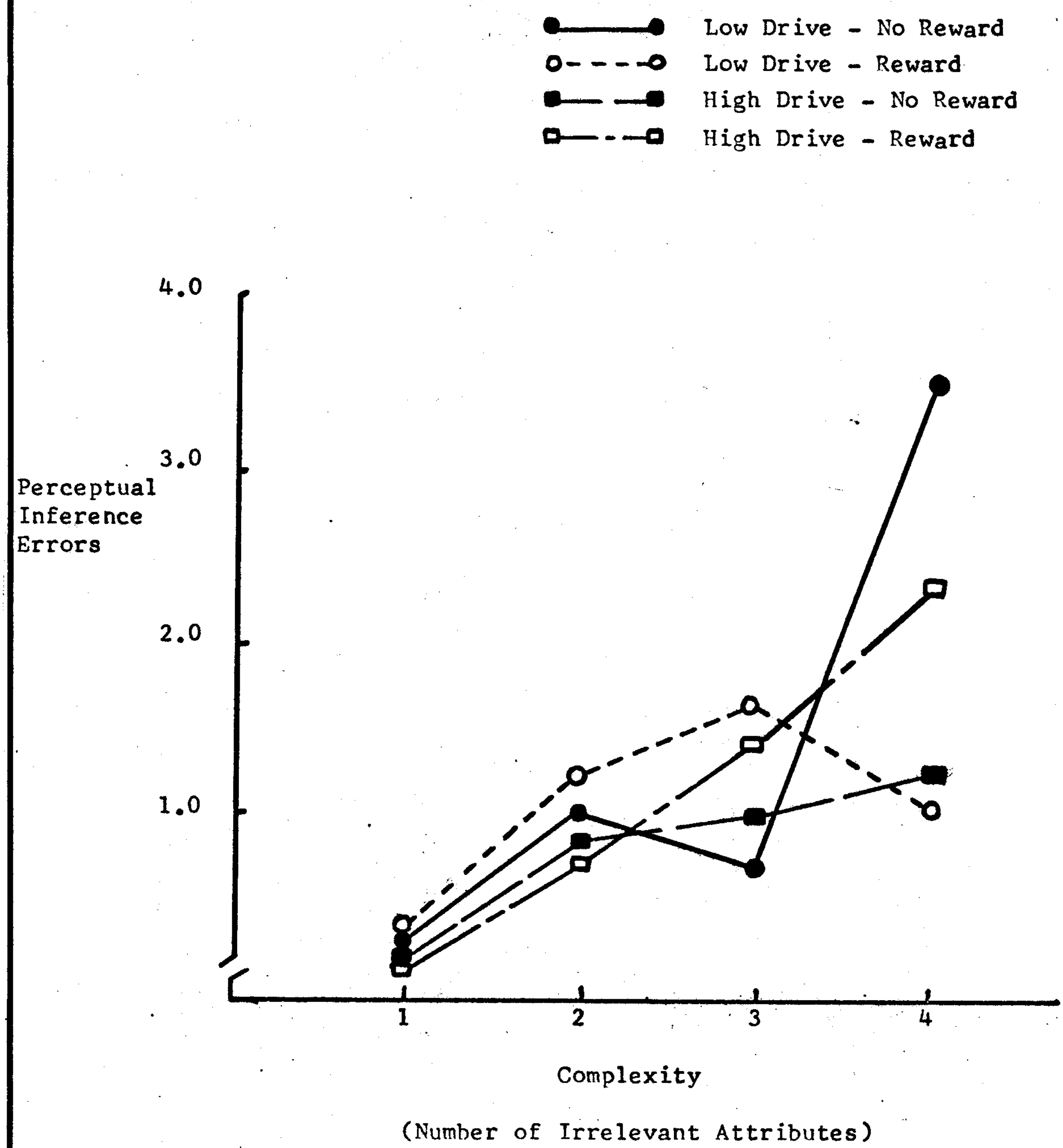
Analysis of Variance For Perceptual Inference Errors With Complexity And With Successive Problems As Repeated Measures

Source	df	SS	MS	F
Classification (C)	1	3.83	3.83	1.19
Drive (D)	1	5.78	5.78	1.79
Reward (R)	1	.08	.08	.02
C x D	1	.00	.00	.00
C x R	1	5.25	5.25	1.63
D x R	1	9.45	9.45	2.93
C x D x R	1	.03	.03	.01
Error (Between Subjects)	72	232.32	3.23	
Complexity (Co)	3	126.31	42.10	16.94***
Co x C	3	3.43	1.14	.46
Co x D	3	4.13	1.38	.55
Co x R	3	17.58	5.86	2.36
Co x C x D	3	.26	.09	.03
Co x C x R	3	3.26	1.09	.44
Co x D x R	3	58.91	19.64	7.90***
Co x C x D x R	3	.38	.13	.05
Error (Within Subjects)	216	536.98	2.49	
Problems (P)	3	17.16	5.72	1.84
P x C	3	5.18	1.73	.56
P x D	3	3.08	1.03	.33
P x R	3	16.98	5.66	1.82
P x C x D	3	7.11	2.37	.76
P x C x R	3	5.56	1.85	.60
P x D x R	3	16.71	5.57	1.79
P x C x D x R	3	7.68	2.56	.82
Error (Within Subjects)	216	671.78	3.11	

*** $p < .001$

Figure 8

Drive x Reward x Complexity Interaction
For Perceptual Inference Errors



PSI scores were obtained by substracting each of the stimulus relevant prints (prints four through seven) from the basal level print (print three) (Haywood & Spielberger, 1966). A constant of 50 was added to each different score to avoid negative values. No significant effect between subjects occurred nor did any effect within subjects for complexity occur (see Tables 23, 24 and 25). There was, however, a significant effect for successive problems, F (3, 216)= 8.51, $p < .001$ (see Tables 22 and 23). The first card presented differed significantly from the second problem at the .01 level, while the second problem was significantly different from both the third ($p < .05$) and the fourth ($p < .001$) problems. The trend is neither significant linearly, F (1, 216)= .36, n.s., nor quadratically F (1, 216) = .00, n.s.

Correlations between dependent variables

The following correlations were calculated using the sums of the dependent variables for each subject. In other words, the scores were summed across problems for each subject and then were correlated (see Table 26). Focusing strategy correlated with scanning strategy at .37, with untenable hypotheses at -.45, with choices at -.45, with time at -.26, with perceptual inference errors at -.55 and with palmar sweat scores at -.14.

Table 23

Means For Palmar Sweat Index With
Complexity As Repeated Measure

	Complexity (Irrelevant Attributes)				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	49.50	50.30	49.60	50.70	200.10
Reward	54.80	47.50	49.00	52.20	203.50
High Drive					
No Reward	51.30	54.40	49.90	46.10	201.70
Reward	48.80	50.30	50.30	50.70	200.10
Schizophrenic					
Low Drive					
No Reward	51.40	54.90	50.20	50.60	207.10
Reward	47.30	49.80	48.30	48.10	193.50
High Drive					
No Reward	47.20	46.10	46.80	49.10	189.20
Reward	51.60	55.70	52.20	51.80	211.30

Table 24

Means For Palmar Sweat Index With
Successive Problems As Repeated Measure

	Successive Problems				
	1	2	3	4	Total
Non Schizophrenic					
Low Drive					
No Reward	50.80	53.70	47.00	48.60	200.10
Reward	49.90	51.90	50.70	51.00	203.50
High Drive					
No Reward	49.40	55.50	51.50	45.30	201.70
Reward	49.50	52.00	50.30	48.30	200.10
Schizophrenic					
Low Drive					
No Reward	52.20	54.80	52.00	48.10	207.10
Reward	47.60	51.10	47.20	47.60	193.50
High Drive					
No Reward	47.10	49.00	47.10	46.00	189.20
Reward	50.90	55.30	54.30	50.80	211.30

Table 25

Analysis of Variance For Palmar Sweat Index With Complexity And With Successive Problems As Repeated Measures

Source	df	SS	MS	F
Classification (C)	1	5.75	5.75	.03
Drive (D)	1	1.13	1.13	.01
Reward (R)	1	33.13	33.13	.18
C x D	1	.95	.95	.01
C x R	1	14.10	14.10	.08
D x R	1	294.57	294.57	1.57
C x D x R	1	517.56	517.56	2.76
Error (Between Subjects)	72	13479.38	187.21	
Complexity (Co)	3	110.30	36.77	.96
Co x C	3	75.89	25.30	.66
Co x D	3	64.41	21.47	.56
Co x R	3	49.31	16.43	.43
Co x C x D	3	229.84	76.61	2.00
Co x C x R	3	216.79	72.26	1.89
Co x D x R	3	102.71	34.24	.90
Co x C x D x R	3	189.68	63.23	1.65
Error (Within Subjects)	216	8252.32	38.20	
Problems (P)	3	929.50	309.83	8.51***
P x C	3	10.94	3.65	.10
P x D	3	94.81	31.60	.87
P x R	3	126.81	42.27	1.16
P x C x D	3	81.89	27.30	.75
P x C x R	3	65.44	21.81	.60
P x D x R	3	8.51	2.84	.08
P x C x D x R	3	106.63	35.54	.98
Error (Within Subjects)	216	7866.72	36.42	

*** $p < .001$

Table 26

Correlations of Dependent Variables

	Scanning	Untenable Hypothesis	Choices	Time	Perceptual Inference Errors	Palmar Sweat Index
Focusing	.37	-.45	-.45	-.26	-.55	-.14
Scanning		-.56	-.78	-.49	-.64	-.17
Untenable Hypothesis			.88	.53	.85	.15
Choices				.55	.86	.15
Time					.55	.18
Perceptual Inference Errors						.12

Scanning strategy correlated with untenable hypotheses at -.56, with choices at -.78, with time at -.49, with perceptual inference errors at -.64, and with palmar sweat scores at -.17. Untenable hypotheses correlated with choices at .88, with time at .53, with perceptual inference errors at .85, and with the palmar sweat scores at .15. Choices correlated with time at .55, with perceptual inference errors at .86, and with palmar sweat scores at .15. Time correlated with perceptual inference errors at .55 and with the palmar sweat index at .18. Perceptual inference errors correlated with the palmar sweat index at .12.

Summary of results

A 2x2x2x4 repeated measures factorial design was used. Two analyses of variance were done for each dependent variable, one for the complexity of problems and one for successive problems as repeated measures. For focusing strategy, a complexity effect indicated that as problems became more complex, less focusing occurred. For scanning strategy, a drive x reward interaction occurred wherein the high drive group performed more poorly under the reward condition. Also, when analyzing scanning for complexity, a complexity effect showed that, as problems increase in complexity, less scanning strategy is employed. A triple interaction, drive x reward x complexity, occurred for scanning, with differences between groups being significant only on the most complex task. For untenable hypotheses, an effect showed that, as complexity increased more untenable hypotheses were submitted. Also, a reward x complexity effect demonstrated that, although no differences between the reward groups occurred on the less complex problems, subjects receiving reward on the most complex problem performed better than those receiving no reward. A drive x reward x complexity interaction for untenable hypotheses revealed intergroup differences only on the most complex task. For choices, a complexity effect revealed that, as complexity increased, subjects made more card choices. A drive x reward x complexity interaction also occurred for choices, wherein significant intergroup differences occurred only on the most complex task. Also, an effect for successive problems was evident, showing that as problems were presented successively, more choices were made. For time, an effect demonstrated that, as complexity increasec, time also increased. A drive x reward x complexity interaction occurred for time with intergroup differences only on the most complex task. For perceptual inference errors, an effect revealed that as complexity increased, more perceptual inference errors occurred. A drive x reward x complexity effect obtained with significant intergroup differences only on the most complex problem. For the palmar sweat index, a significant effect for successive problems occurred, showing that as problems were presented successively, an increase on the first problem and then a consistent decrease in palmar sweating occurred.

The primary findings were: (1.) a drive x reward interaction for scanning; (2.) a complexity effect for all dependent variables except the palmar sweat index; (3.) a reward x complexity effect for untenable hypotheses; (4.) a drive x reward x complexity effect for scanning, untenable hypotheses, choices, time and perceptual inference errors; (5.) a successive problems effect for choices; and (6.) an effect for successive problems for the palmar sweat index. Correlations between dependent variables were generally high, except for correlations with the palmar sweat index.

Chapter V. Discussion

This study is one of the first to utilize Bruner, Goodnow and Austin's (1956) concept formation task with a psychiatric population in the investigation of schizophrenic thought processes. The Bruner task has principally been used with students. The task was chosen for this study because prior research with schizophrenic thinking, as presented in the introduction, has generally made use of tasks possessing an affective component in the stimulus material itself. This concept formation task presents essentially nonaffectually arousing stimuli and taps the more formal, structured thought processes. Since the tasks are not intrinsically affectually arousing and contain only geometric designs, the tasks seem highly appropriate to tap schizophrenics' conceptual abilities. This more theoretical point of view was substantiated by the interest and exceptionally long attention span exhibited by the schizophrenic subjects.

The hypotheses for this study were derived primarily from the theories of Goldstein, Cameron, and Mednick. These three theoreticians were considered by this researcher to have taken positions which were not entirely accurate.

The competing hypotheses reflect the essential differences of the three theoreticians and also reflect this experimenter's view. Hypotheses I (Cameron), II (Goldstein) and III (Mednick) predict differences between schizophrenics and non-schizophrenics. Hypothesis IV (this researcher) suggests that if drive levels are controlled for schizophrenic and non-schizophrenic groups, there will be no significant differences in the concept formation processes evident on the Bruner, Goodnow and Austin task between schizophrenics and non-schizophrenics.

At first glance, it would appear that the intent of this project is to prove the null hypothesis. The intent instead is to demonstrate that the theories of Goldstein, Cameron and Mednick are not sufficient to account for the performance of schizophrenics and non-schizophrenics when drive levels are controlled and also when a formal, conceptual task is employed. The hypotheses then must not be evaluated individually in terms of the null hypothesis, but rather the four primary hypotheses must be considered as an integrated whole. The nature of the experimental design allows this integration to occur. When such a conceptual integration is accomplished, it is evident that the pitfall of attempting to prove the null hypotheses is not directly applicable to this study.

Before discussing the significant effects, it should be noted that the perceptual inference error scoring was slightly different from Cahill and Hovland (1960). By inspecting the data in this study, it was found that subjects frequently made errors inconsistent with information available on the two previous instances. Two such successive errors were scored as perceptual inference errors. This procedure contrasted with Cahill and Hovland (1960) who defined such errors as arising from only the <u>one</u> previous instance. It seems that an inpatient psychiatric population perhaps experiences more memory difficulties than a non-psychiatric population because of intrusive anxiety. Therefore, the dependent variable was evolved into a more precise measure by including two, rather than only one, perceptual inference error.

Main effects

Cameron would expect a main effect for classification into schizophrenic and non-schizophrenic. He believed that schizophrenics should perform more poorly than non-schizophrenics because the schizophrenic over-generalizes and over-includes more.(Hypothesis IA). Yet, the results of this study demonstrate that on this formal conceptual task, there is no main effect for classification.

Since the commonly accepted notion is that the schizophrenic's poor conceptual performance results from his inability to focus on the test material and to avoid being distracted by irrelevant stimuli, the finding of this study that the performance of schizophrenic and non-schizophrenic psychiatric patients does not differ significantly on conceptual tasks is indeed alarming. The implication of this finding is that researchers and clinicians may possibly have been unable to tap those conceptual abilities available to the schizophrenic. By the nature of the Bruner task, the schizophrenic's ability to integrate and to focus upon a mass of material now becomes evident. The lack of a significant main effect for classification is supported by McGaughran and Moran's (1956) finding that chronic paranoid schizophrenics did not differ in their conceptual ability from non-psychiatric controls. McGaughran and Moran emphasized that the schizophrenic deficit was the inability to communicate socially. It seems highly relevant that the schizophrenic cognitive deficit must also be related, to the nature of the task involved. To insure the schizophrenic's maximal performance, the stimuli should probably be non-affectually arousing in nature, thereby limiting the number of idiosyncratic associations available to the schizophrenic. Further research is certainly suggested in evaluating the nature of the stimulus and the task itself along the continuum of non-affectual to affectually stimulating material. It would be expected that the schizophrenic's conceptual abilities would diminish as the task became more and more emotionally arousing.

The similarity of schizophrenics and non-schizophrenics in this study may be accounted for by balancing of the groups on the basis of drive levels, in addition to the non-affectual content of the task. In previous studies it is fairly evident that the subject groups did not possess similar drive levels, thereby contributing to the significant differences found between schizophrenic and non-schizophrenic behavior.

Mednick would predict a significant main effect in this study for drive (Mednick, 1958). He believed that, because high drive fosters greater generalization in responding to irrelevant cues, high drive subjects should have more difficulty in concept formation than low drive subjects (Hypothesis IIIA). Yet there was no significant main effect for drive in this study. This finding suggests possibly that Mednick's formulation is inaccurate regarding more formal conceptual tasks. Hill (1960) on the other hand believed that high drive should strengthen relevant responses in a manner directly proportional to irrelevant responses. Hill, therefore, would have expected no main effect for drive (Hypothesis IIIA1). Hill's expectation was supported by the data. It must be noted once again that confirmation of such an expectation does not prove it, but only suggests possible credence.

There were significant main effects within the repeated measures factor for both complexity and successive problems. A linear complexity effect obtained for all the dependent variables, except for the palmar sweat index. Such a consistent effect occurred, because, as problems became more complex and more difficult, the process of forming concepts and of cognitively dealing with the tasks became more difficult. None of the hypotheses was directly concerned with this finding. It should be noted that for scanning strategy and untenable hypotheses, the number of possible hypotheses increases as the complexity level increases. For example, for one relevant attribute, three possible hypotheses exist; for two relevant attributes, six hypotheses; for three, ten hypotheses; and for four relevant attributes, 15 possible hypotheses exist. Therefore, the significant complexity effects for scanning and untenable hypotheses include and might be accounted for by the greater number of hypotheses for increasing levels of complexity. However, a complexity effect exists for the number of card card choices, indicating that the greater number of hypotheses cannot singularly account for the complexity effects for scanning and untenable hypotheses. The consistent complexity in the dependent variables related to concept formation is consonant with the findings of Battig and Bourne (1961). The number of trials to criterion in a concept indentification task increased with the number of irrelevant dimensions; ie., concept formation was more difficult with more irrelevant dimensions (Battig and Bourne, 1961). Other studies supporting a complexity effect are Bourne (1957), Bourne and Pendleton (1958), and Bourne and Haygood (1959).

A rather peculiar effect for successive problems occurred when analyzing the choices dependent variable. The number of card choices increased with significant linearity as problems were presented. The contrary is expected if learning is taking place. That is, if learning is occurring, then fewer cards should be chosen as problems are presented. Probably a fatigue effect is operating that would cause subjects to be less cautious in their card choices, even though the examiner instructed them to choose as few cards as possible. If a fatigue effect is operating, a successive problems effect should occur for time, but there is no such significant effect. Therefore, it can be stated that a partial fatigue effect is occurring, which allows these psychiatric subjects to neglect the instructions and to be less discriminative in choosing cards, but which does not augment the time spent on each problem.

A successive problems effect also obtained for PSI scores. The means were as follows: first problem = 49.68; second problem = 52.91; third problem = 50.01; fourth problem = 48.21. The first problem does not fit into the otherwise linear trend, since when that problem was presented and the print was taken, the subject did not understand the nature of the task. On subsequent problems, subjects were fully aware of the nature of the task. The negative linear trend for the second, third and fourth successive problems represents a physiological adaptational effect.

First order interactions

A significant drive x reward interaction obtained for scanning strategy. The interaction was accounted for by the debilitated performance of high drive subjects under the reward condition. The decreased performance for high drive subjects is expected by arousal theory. Arousal theory suggests that there is a curvilinear relationship (an inverted U function) between behavioral efficiency and measures of arousal (Cofer & Appley, 1966). To expect high drive subjects to perform more poorly with increased motivation necessarily places them on the right hand half of the motivational continuum and of the inverted U. Let us clarify how high drive and low drive were defined in this study.

An important difference exists in the operational definition of high and low drive for psychiatric inpatients in this study and the operational definition of high and low drive for a non-clinical population. Low drive is defined as those MAS scores falling at 24 and below, whereas low drive for a non-clinical population, usually college students in MAS research, is approximately at nine and below. The mean (17.1) for psychiatric low drive subjects then falls at approximately the 50 percentile for non-clinical subjects. High drive is designated in this study as those scores at 29 or above on the MAS, whereas high drive in a non-clinical population is approximately at 19 and above. The mean (34.6) for these psychiatric high drive subjects falls at approximately the 98 percentile for non-clinical subjects. Therefore, about 75 percent of the subjects in this study may be considered to be high drive subjects according to non-clinical norms.

The high drive subjects in this study fell at the upper end of the motivational continuum, performed more poorly under reward conditions, and thus coincided with the predictions of arousal theory for the drive x reward interaction for scanning strategy. Since scanning involves difficult memory requirements, the debilitation of the high drive group receiving reward apparently reflects a decrease in the ability of high drive subjects to utilize their memory capacities under conditions of reward or increased motivation.

The other significant first order interaction was a reward x complexity interaction for untenable hypotheses. The interaction was accounted for by the reward group performing better on the most complex task than the no reward group, while the other levels of complexity did not contribute to any significant differences. Using a conceptual model for arousal similar to the model described above, the improved performance of the reward group was certainly unexpected. Since subjects in this study fall principally on the upper half of the inverted U continuum, any increase in motivation should debilitate and not enhance performance. This finding certainly needs to be investigated further. It is possible that the subjective value of reward on this most complex task is minimal when considering it across subjects and drive. The subject may tend to value the cognitive challenge of the task more than the subjective value of the reward. By subjectively devaluing the reward, he concomitantly minimizes his motivation, thereby allowing himself to perform more effectively. Since untenable hypotheses involve a memory component, the decreased motivation probably reflects an enhance memory capacity. None of the hypotheses in the study directly relate to this interaction between reward and complexity.

Many of the hypotheses were concerned with first order interaction which never achived significance. Cameron's idea that schizophrenics confronted with a complex problem would function more poorly than schizophrenics confronted with a simple problem (Hypothesis IB) because of overinclusion and overgeneralization, could be demonstated in a classification x complexity interaction. Goldstein would predict the same interaction since the schizophrenic apparently thinks in a concrete fashion (Hypothesis IIA). Also, Mednick would predict a similar classification x complexity interaction, since schizophrenics should possess wider generalization gradient and respond to more irrelevant cues than non-schizophrenics (Hypotheses IIIC1 and IIIC2). No classification x complexity interaction achieved significance in this study. Again, such results do not disprove the hypotheses, but do seem to lend some doubt as to their accuracy and applicability to the subjects and the task employed, particularly because of the tight experimental methodology utilized in this study.

Goldstein and Mednick would have predicted that a classification x drive effect would obtain. Goldstein would reason: conrete thinking results from avoiding catastrophic anxiety; some schizophrenics have minimized their anxiety by thinking in a concrete fashion (low drive schizophrenics); other schizophrenics have not minimized their anxiety effectively (high drive schizophrenics); since low drive schizophrenics think in a concrete fashion, they should perform more poorly on conceptual tasks than high drive schizophrenics. Mednick would reason: high drive schizophrenics have more irrelevant response tendencies because of higher drive contributing to a broader generalization gradient; low drive schizophrenics and non-schizophrenics have fewer irrelevant response tendencies because of lower drive; therefore, drive and classification should interact significantly. Yet, not such effect obtained significance in this study.

Finally, Mednick would have postulated a drive x complexity effect (Hypothesis IIIB). High drive should elicit more irrelevant response tendencies than low drive. On complex tasks more irrelevent cues are available and should then be elicited by high rather than by low drive. Again, there was no significant drive x complexity effect in this study.

The three interactions hypothesized in the last three paragraphs (classification x complexity, classification x drive, and drive x complexity) all seem to assume that drive levels in schizophrenic and in non-schizophrenic disorders cannot be equated. It is this writer's contention that none of these three interactions obtained significance in this study because drive levels were equated for both classification groups. In this manner it was possible to prevent the confound between drive and schizophrenia, which may have been clouding the perceptions of the three theoreticians.

Second order interactions

A rather consistent interaction, drive x reward x complexity, obtained for scanning, untenable hypotheses, choices, time and perceptual inference errors. Subject groups significantly differed only on the most complex problems. Arousal theory was utilized in interpreting the results. An inverted U continuum for motivation (low to high) was placed on the x-axis and performance on the y-axis (poor to good). The subjects within this study fall principally within the fiftieth to ninety-ninth percentile of non-psychiatric MAS scores. Therefore, the expected rank order of performance from good to bad for subject groups within the triple interaction was: low drive-no reward; low drive-reward; high drive-no reward; high drive-reward. The expected order is based on arousal theory: increasing drive levels in the upper half of the motivational continuum yield decreasing performance. Untenable hypotheses, choices, time and perceptual inference errors seem to follow a consistent pattern on the most complex problem. Low drive-reward, high drive-no reward and high drive-reward groups usually demonstrate no significant differences or are ordered in the manner expected by arousal theory. The low drive-no reward group seems to defy expectations, since it consistently performs worse than all four groups. High drive-reward subjects are always rank ordered just above the low drive-no reward group. It is extremely important to note that the non-verbal intelligence scores showed that the low drive-no reward group possessed significantly less non-verbal intelligence than the high drive-reward group ($p < .05$). The SRA non-verbal task is essentially a concept formation task in which series of five pictures or diagrams are presented. One of the five pictures must be designated as not belonging with the other four. The series increases in difficulty from simple to quite complex problems. Since the low drive-no reward group is less bright on non-verbal intelligence, the reversal of the low drive-no reward group from the predictions of arousal theory could be attributed to the group's lower of non-verbal intelligence; i.e., poorer conceptual ability. The mean non-verbal intelligence score is lower than all other cell means, but is significantly different only from the high drive-reward group. A confound then appears to exist for this triple interaction, and it occurs even though subjects were randomly assigned to reward groups.

The rank order of group means for the drive x reward x complexity interaction for scanning strategy is slightly different from the other dependent variables. The positions of the high drive-no reward and low drive-reward groups are reversed, so that high drive-no reward groups perform better than the low drive-no reward group at the .05 level. For scanning, possibly the performance of low drive subjects is so enhanced by the incentive of reward that the motivational level attained with reward is higher than the motivational level of high drive-no reward subjects. Since this finding occurs only for scanning, the enhanced performance is probably a function of improved memory. This problem should certainly be investigated more specifically to clarify the notions presented.

Comments

No significant differences in PSI scores were noted for non-schizophrenic and schizophrenic groups, for high and low drive groups, nor for any interaction between the two. These similarities between groups might be a confound of the use of phenothiazines for the schizophrenic group ($p < .05$). The intent of the phenothiazine prescription is to minimize excessive autonomic arousal and to allow subjects to utilize their cognitive abilities. Previous studies on concept formation tasks with psychiatric subjects have generally not reported data regarding medications. Therefore, studies reporting differences between schizophrenics and non-schizophrenics were subject to the same medication confound as was this study. It is necessary then to investigate the issue of arousal in psychiatric patients in a more well-controlled drug study.

It is curious that focusing did not delineate any significant differences between groups. Perhaps focusing taps the more formal logical capacities within subjects. Scanning, on the other hand, seems to tap the memory functions in subjects. If this differentiation between focusing and scanning is accepted, then the difference between drive groups under reward and no reward conditions can be attributed to variability in the capacity to utilize memory, rather than in the ability to excercise formal logic.

The correlation between focusing and scanning in this study was notably lower than previous studies with a college student population, as in Laughlin (1966). The correlations between the other dependent variables were also notably different.

These differences may readily be accounted for by the different natures of a college student and a psychiatric population. Perhaps within the psychiatric population, there is a greater intrusion of anxiety which would debilitate effective memory functioning, while in the student sample, a lower level of anxiety would be present.

An implication for the treatment of schizophrenics is suggested. Since this study reveals that schizophrenics can function cognitively in a similar fashion to non-schizophrenics on a formal conceptual task, it may be advantageous to encourage schizophrenics to perform on such tasks as part of treatment. When success on such tasks occurs, it is expected that some increase in self-esteem and motivation to participate in the therapeutic program may occur. The tasks may then be gradually increased along the continuum of non-affective to affectively arousing tasks. Perhaps some generalization may occur in which the success in dealing with non-affectual cognitive tasks may be experienced in dealing with affectually arousing tasks.

The novelty of this research project should be emphasized. The literature does not reveal any study utilizing Bruner, Goodnow, and Austin's (1956) concept formation task with a psychiatric population. The literature also does not contain any study to date on schizophrenic thinking in which a schizophrenic and a control group have been balanced for drive levels. Nowhere could a study be found which investigated the effects of non-verbal reward on a concept formation task. Nowhere could studies be found which attempted to relate physiological functioning with the thinking process on the concept formation task used in this study.

Chapter VI. Summary

A 2x2x2x4 repeated measures factorial design was used with the following variables: (1) Classification (non-schizophrenic or schizophrenic inpatients); (2) Drive (low or high); (3) Reward (no or yes); (4) Problems (one, two, three or four irrelevant attributes on a concept formation task). Repeated measures were analysed for both the complexity of problems and for the successive presentation of problems. The dependent variables included focusing strategy, scanning strategy, untenable hypotheses, card choices, time, perceptual inference errors, and palmar sweat index. For scanning strategy, high drive subjects performed more poorly under reward than non-reward conditions. As problems became more complex, subjects had more difficulty performing; this was a linear trend for all dependent variables except for the palmar sweat index. For untenable hypotheses, subjects receiving reward performed better than non-reward subjects, but only on the most complex task. A drive x reward x complexity effect revealed rather consistently that only on the most complex task, groups were rank ordered as follows: low drive-reward performed best; then high drive-no reward; then high drive-reward; then low drive-no reward.

As problems were presented successively, more choices occurred. An adaptational effect occurred for the palmar sweat index for successive problems. Correlations between dependent variables were generally high except for those with the palmar sweat index. Results were interpreted primarily in terms of arousal theory and the exceptionally high level of drive of the psychiatric subjects. Popular theories of schizophrenia were not supported, though not disproven.

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APPROVAL SHEET

The dissertation submitted by Donald Edward Fuhrmann has been read and approved by members of the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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